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Principles: Compression, Tension and Compensation

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SOUNDBOARD FOR PIANOS

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7 Claims. (Cl. 84—192)

The Diaphragmatic Crowned Soundboard

This invention relates to soundboards for pianos, and has for its object to provide an improved soundboard so constructed, and so supported to the piano frame as to act like a true diaphragm. By true diaphragm is meant a member which is acted upon by a driving force without any impeding obstructions.

The improved soundboard is so constructed as to have its greatest thickness at a point known as the geographical center of the board. The soundboard from this point of greatest thickness tapers to its thinnest portions at the rim of the board. The soundboard is so combined with the frame of the piano that the intended diaphragmatic action of the soundboard is not essentially impaired.

The invention consists further of an improved soundboard tapering from its point of greatest thickness to the rim portion, and held in a position wherein its upper surface is convex and subjected to stretching actions of the fibers of the board, and the lower surface is preferably concave and subjected to compression actions of the fibers of the board. In such an arch, or crown shaped board, the pressure of the string tensions on the bridge on the convex side of the board causes a downward pressure on the board and to some extent neutralizes the stretching of the fibers on the convex upper side of the board, and the compression of the fibers on the lower side of the board. This neutralizing or compensatory action enables the amplitudes of vibration from the thickest portion of the board to its rim portion to be unimpaired and the true diaphragmatic action of the board to be obtained.

The invention consists further of the combination of such a board with a piano frame having compensating parts so that the entire rim portion of the board is uniformly and fixedly supported in a manner whereby the board is not subjected to influences counteracting its true diaphragmatic action.

The invention will be further described hereinafter, embodiments thereof will be shown in the drawings, and the invention will be finally pointed out in the claims.

In the accompanying drawings,—

Figure 1 is a plan view of the lower surface of the initial outline of the soundboard blank and showing the soundboard itself cut out therefrom, with the ribs applied to the lower surface of the board and the bridges shown in dotted lines on the other side of the board.

Figure 2 is a section taken along the line 2—2 of Fig. 5 of the soundboard without the bridge and ribs, and showing the initial position of the soundboard;

Figure 3 is a sectional exploded view of a caul, of the soundboard in its normal or initial position and of a bridge member, preparatory to the curving of the improved soundboard; the caul, soundboard, and bridge member being extended to show the same before assembling;

Figure 4 is a sectional view of the soundboard with bridge and rib members applied thereto showing the same in position in another caul, having the shape of the soundboard resulting from the operation carried out in Fig. 3, the section being taken on line 4—4 of Fig. 1;

Figure 5 shows a plan view of the soundboard with the bridge member applied thereto after the soundboard has received the curvature of the caul shown in Fig. 3, the ribs not being shown;

Figure 6 is a section taken on line 6—6 of Fig. 5 showing the soundboard with its bridge and ribs applied to a frame of a piano;

Figure 7 is a section taken on line 7—7 of Fig. 6 to show the compensating member applied to the frame of the piano; and

Figure 8 is a detailed section of one part of the frame of the piano showing a different form of compensating element.

Similar characters of reference indicate corresponding parts throughout the various views.

Referring to Fig. 2, a soundboard 9 is there shown which has its greatest thickness along the vertical line indicated by 10—10. The thickness of the soundboard decreases toward its rim portion and is smallest at the rim portion as indicated by the vertical lines 11—11. The intermediate vertical lines 13, 14, 15 and 16 indicate vertical planes of curved cross section corresponding to the curved lines in dot-dash arrangement shown in Fig. 5. At the greatest thickness of the soundboard shown in Fig. 2, namely, on the line 10—10, the geographical center of the soundboard is located. In other words, the geographical center of the board is found and the curvature of the board is then arranged so that the greatest depth of the board is at the geographical center. This geographical center in Fig. 5 is indicated by the character 20, and the larger bridge 19 preferably passes over substantially the geographical center.

It will be noted in Fig. 2 that the lower surface 21 of the embodiment of the soundboard there shown is planular and that the upper surface 22 is convex and preferably of parabolic shape.

Referring now to Fig. 1, the exterior configuration indicated by 23 shows the shape of the

board before it is cut in outline to its final shape as is indicated by 24 in Fig. 1, which final shape corresponds to a grand piano soundboard shape. With a soundboard of the shape indicated by 24 in Fig. 1, and also in Fig. 5, and of a cross section such as shown in Fig. 2 at hand, the soundboard is placed with the plane surface 21 lowermost and the convex surface 22 uppermost, upon a caul 25, as shown in Fig. 3. This caul has an upper surface 26 of convex shape of less curvature than the curvature of the convex side of the soundboard 9 of Fig. 2. The soundboard 9 is then pressed downward against the convex surface 26 of the caul 25 until it conforms with the convex shape 26. By this action, the convex surface 22 of the soundboard 9 is given a greater convexity than is shown in Fig. 2; and the lower surface or the underside of the soundboard is given a concave surface. Thereby the fibers of the wood are under compression at the concave side, whereas the fibers of the wood at the convex side are stretched or are under tension. The soundboard 9 is thereby subjected to a compressive stress on the under side and a tensile stress on the upper side.

With the soundboard 9 firmly held in this position, the surface 21 registering with the surface 26, the large bridge piece 19 is then applied to the convex surface of the board 9, such application being by means of gluing and pressure. When the glue is dry, the soundboard 9 and the bridge 19 are so firmly secured together that the board 9 cannot spring back to its initial position. When the board 9 has been given this additional convexity just referred to, the surface 27 of the bridge 19 corresponding to the desired final convex position of the soundboard 9, then the soundboard is taken away from the caul 25. It is reversed in position and placed onto another caul indicated by 28, having a slot 29 into which slot the large bridge 19 seats. If a smaller bridge 30 has been applied to the soundboard, a separate slot is provided for it in the caul 28. The caul 28 has a concavity equal to that of the convexity of the soundboard 9 when it is placed upon the caul 28.

When the soundboard 9 has been placed in proper position on the caul 28, then ribs 31 are applied thereto by gluing and by pressure, the ribs being parallel with each other, and after the ribs have been properly secured to the soundboard, the soundboard 9 is removed from the caul 28. The soundboard held by the bridge or bridges and by the ribs is then permanently held in its fixed arch or crown shape.

The soundboard is now ready to act in a piano in the nature of a diaphragm. If it would be placed into a piano frame having a shoulder as indicated by 33 in Fig. 6, if such shoulder were in one single plane, it would be found that the soundboard 9 would be distorted and the very object of having the soundboard act as a diaphragm would be frustrated. Because of the cutting out of the soundboard from its blank 23 in Figure 1, the curved part of the soundboard outline 24 of Fig. 1, between the parts marked x and y, (likewise shown in Fig. 5), it is necessary to provide a compensating element for the frame of the piano in order to properly support the soundboard so as not to impede the vibrating action of the soundboard as a diaphragm essentially throughout its surface. The parts of the soundboard between x and y are higher than the remaining parts of the outline of the soundboard, which latter are substantially in one plane. For this purpose a shim 35 is provided which has its lower surface 36 planular and its upper surface 37 conforming to the shape of the soundboard 9 between the points x and y. When the soundboard 9 is placed upon the shoulder 33 of the frame 34 of the piano, the compensating shim 35 at the curved portion x—y of the soundboard serves to hold the lowermost surface of the soundboard in such a supporting position as to provide an equalized support with the remaining parts of shoulder 33 of the piano frame, not covered by the shim 35.

By virtue of the construction described, the soundboard is held in such a way as to provide a diaphragmatic action free from any bucking strains.

Instead of a separate shim indicated by 35, the frame of the piano 34 can be provided with a curved portion 39 corresponding to the portion x—y of the soundboard, such as shown in Fig. 8, the section alone being shown in Fig. 8, but the curvature of that portion along the piano frame would be similar to the upper curved part of the shim 35. In other words, the piano frame has an integral shoulder around the circumference of the piano frame, upon which the soundboard is seated without the soundboard being subjected to any buckling strains.

After the soundboard 9 has been placed into the piano frame, as described, the usual strings are applied, and these being under tension and passing over the bridge 19, act against the crown shaped soundboard. In other words, the convex part of the soundboard acts in opposition to the string tension. There is necessarily a downward depression in which the fibers of the convex side which are under tension, are brought closer together, and the fibers of the concave side which are under compression, are somewhat separated from each other. The crown shape, even though thus slightly compressed, remains as a crown shape when the piano is in use. In other words, the flexured sounding board remains crown shaped after the tension of the strings is applied, though the concavity may be very shallow.

It will, therefore, be seen that the invention includes a soundboard so constructed as to act as a diaphragm and at the same time so supported that the supporting means do not materially modify or impede the diaphragmatic action of the soundboard.

The peripheral edge portions of the soundboard are securely fixed to the piano frame by gluing.

The soundboard described has for its essential advantage the fact that it vibrates substantially in the manner of a diaphragm fixed at its edges and with a free center. This so-called diaphragmatic mode of vibration is characterized by a tendency for the maximum amplitude of vibration to exist at or near the geographical center of the diaphragm and for this amplitude of vibration to decrease approximately regularly from this center toward the periphery, at which periphery the diaphragm is more or less rigidly supported. One evidence for the existence of this true diaphragmatic mode of vibration in a soundboard is the absence of secondary vibrations. By secondary vibrations is meant vibrations segmentally or otherwise in separate portions. The diaphragmatic action of the soundboard is obtained and maintained by the particular method of mounting described. In previous methods of soundboard mounting, cross strains are created due to the method of mounting, so that vibration of the soundboard as a

single diaphragm became impossible and undesirable segmental vibration became an accompanying necessity.

My improved soundboard vibrates with the greatest amplitude of vibration at or near the geographic center, with the amplitudes of vibration decreasing towards the periphery thereof. This periphery is rigidly held by the piano frame, and preferably in such a way that the above diaphragmatic action may be unimpededly carried out in an essential manner.

It will also be noted that the soundboard due to the special and particular curvature given to it by the means and method described herein, is under compression when the strings press upon it, with its rim anchored upon the piano frame.

The board vibrates over its whole area, with the least dissipation of energy, the entire area vibrating as freely as possible. The edges of the soundboard are tightly held without distortion of the soundboard.

My invention has been illustrated and described with some degree of particularity, but it is understood that changes may be made in the form of details and in the construction and arrangements of parts. Accordingly, I reserve the privilege of resorting to all such legitimate changes therein, as may be fairly incorporated within the spirit and scope of the appended claims.

I claim:

1. A soundboard of grand piano shape, having its greatest thickness substantially at its geographical center, and tapering in thickness circumferentially to the edge of the soundboard, said soundboard being flexured and having its upper side convex and its lower side concave, with the fibers of the convex side subjected to stretching and the fibers of the lower side subjected to compression.

2. In a piano, the combination of a soundboard having its greatest thickness substantially at its geographical center, and tapering in thickness circumferentially to the edge of the soundboard, said soundboard being flexured and having its upper side convex and its lower side concave, with the fibers of the convex side subjected to stretching and the fibers of the lower side subjected to compression, and a piano frame having a circumferential shoulder supporting the edge of the soundboard, said shoulder having varying heights in conformity with the varying heights of the edge of the sound board.

3. In a piano, the combination of a soundboard having its greatest thickness substantially at its geographical center, and tapering in thickness circumferentially to the edge of the soundboard, said soundboard being flexured and having its upper side convex and its lower side concave, with the fibers of the convex side subjected to stretching and the fibers of the lower side subjected to compression, and a piano frame having a circumferential shoulder supporting the edge of the soundboard, said shoulder having varying heights in conformity with the varying heights of the edge of the sound board, said shoulder being in part formed of a shim having a configuration conforming to the varying height of the edge of the soundboard.

4. In a piano, the combination of a soundboard having its greatest thickness substantially at its geographical center, and tapering in thickness circumferentially to the edge of the soundboard, said soundboard being flexured and having its upper side convex and its lower side concave, with the fibers of the convex side subjected to stretching and the fibers of the lower side subjected to compression, and a piano frame having a circumferential shoulder supporting the edge of the soundboard, said shoulder having varying heights in conformity with the varying heights of the edge of the soundboard, said shoulder being integral with the piano frame.

5. In a piano, the combination of a soundboard of grand piano shape, consisting of a crown shaped board being flexured and having a convex shape on one side and a concave shape on the other, with the convex part uppermost, a bridge upon the convex uppermost side, said crown shape being in opposition to the pressure of the string tension, and means for mounting said soundboard in the piano frame to prevent distortion or buckling strains.

6. A soundboard of grand piano shape, consisting of a crown shaped board being flexured and having a convex shape on one side and a concave shape on the other side, with the convex part uppermost, and having its greatest thickness at the geographical center of the board, the board tapering off in thickness circumferentially towards its edge, and a bridge upon the convex uppermost side, said bridge passing diagonally over the board and substantially over its geographical center, said crown shape being in opposition to the pressure of the string tension.

7. In a piano, a soundboard tapered from the center to the edge thereof having a convex upper side and a concave lower side, with the peripheral portion of the soundboard in different planes, and means for supporting the same along the edge of the soundboard without distorting the soundboard, whereby the soundboard vibrates essentially as a single diaphragm.

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SOUNDBOARD FOR PIANOS

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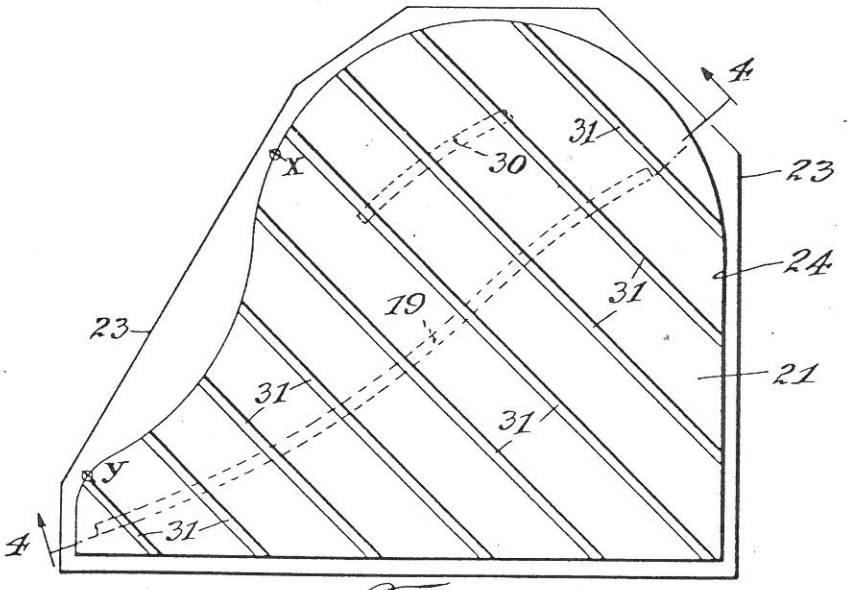

Fig. 1.

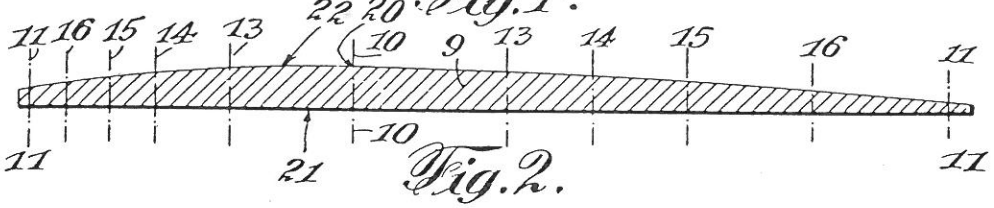

Fig. 2.

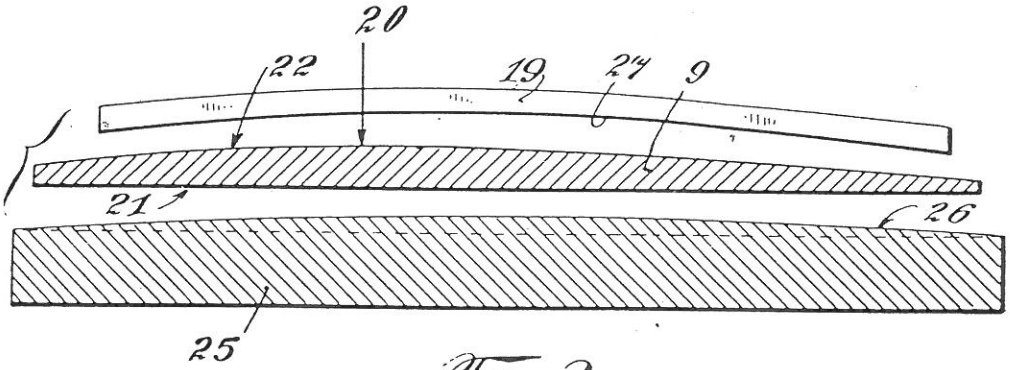

Fig. 3.

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SOUNDBOARD FOR PIANOS

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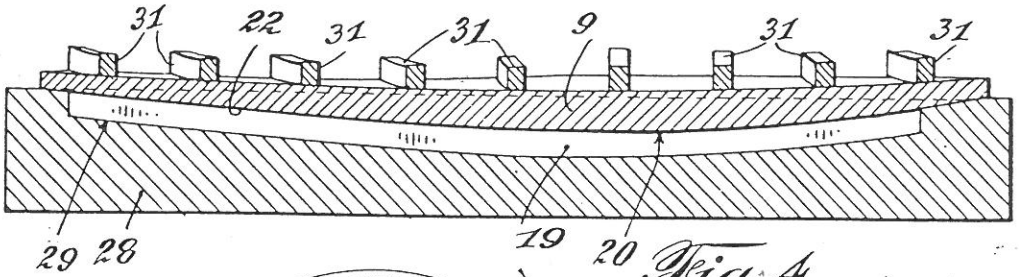

Fig. 4.

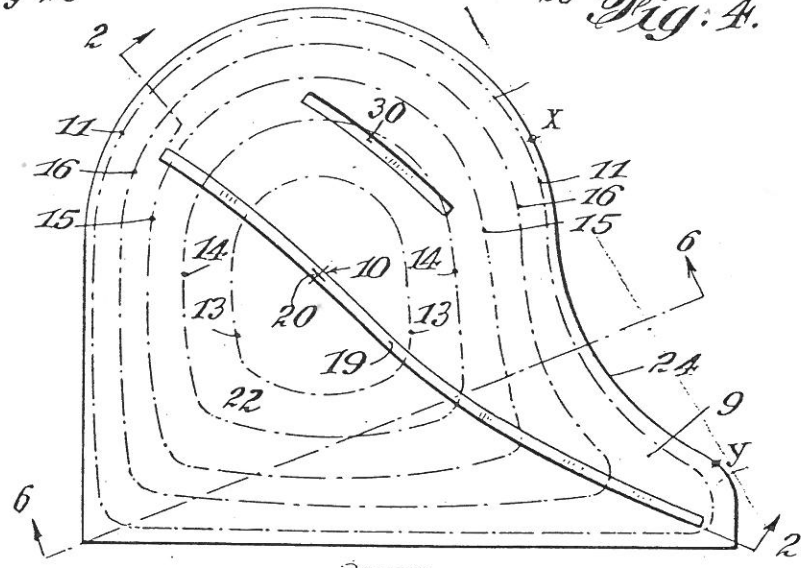

Fig. 5.

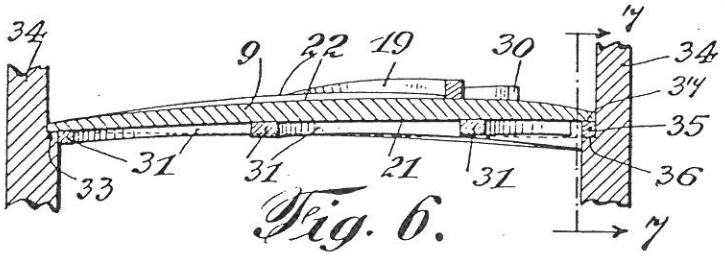

Fig. 6.

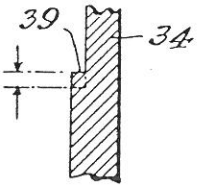

Fig. 8.

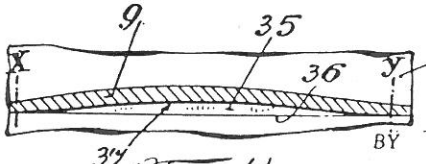

Fig. 7.

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