April 28, 1931. A. NAGELVOORT 1,802,826

SOUND REPRODUCING MEANS

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Fig. 1.

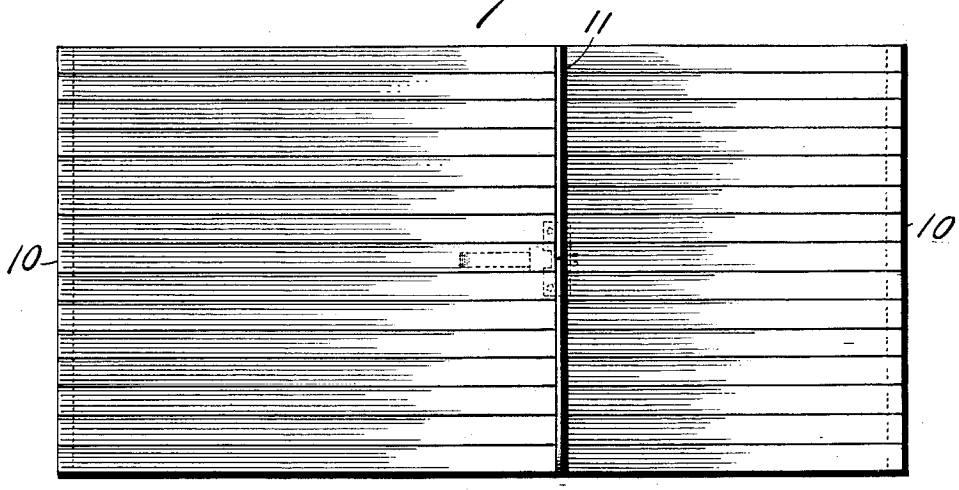


Fig. 2.

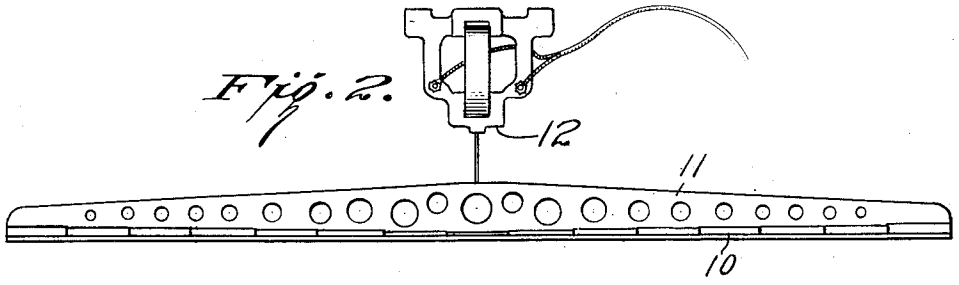
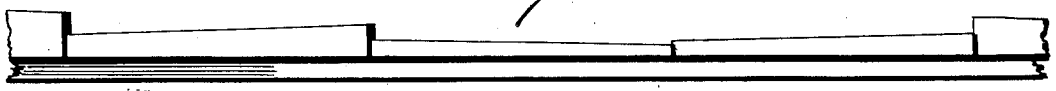


Fig. 4.



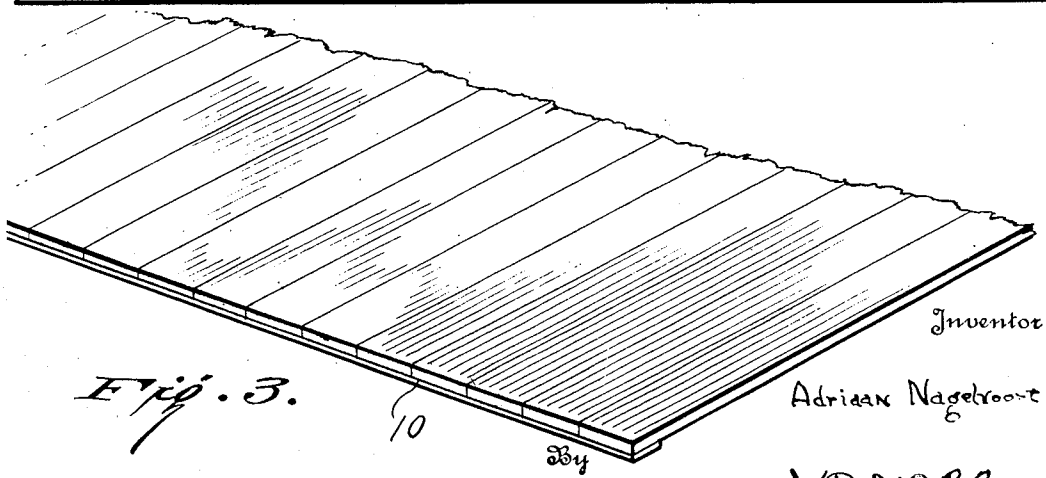


Fig. 3.

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Fig. 5.

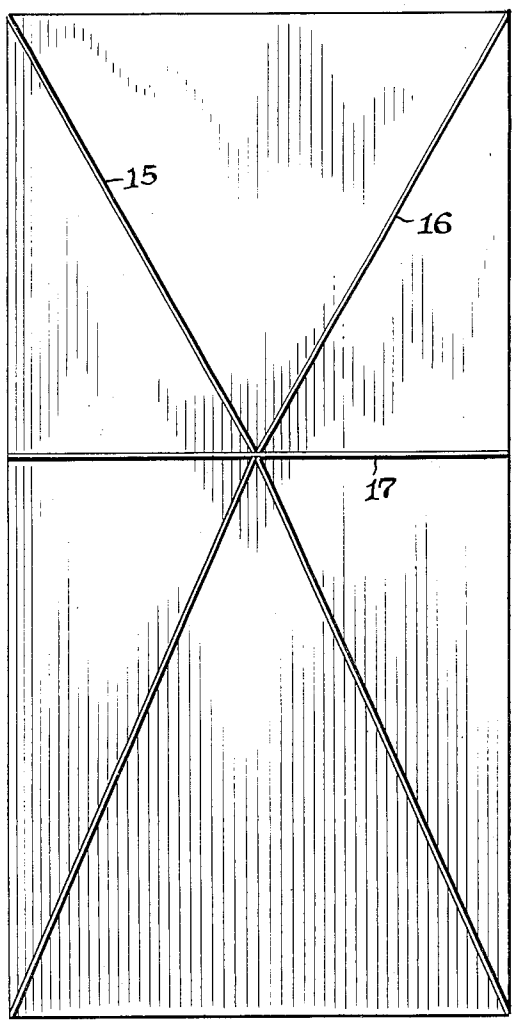
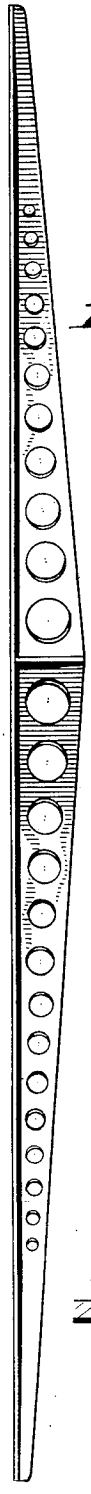


Fig. 6.



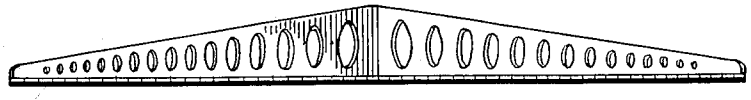


Fig. 7.



Fig. 8.

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UNITED STATES PATENT OFFICE

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SOUND-REPRODUCING MEANS

Application filed July 3, 1929. Serial No. 375,728.

This invention relates to sound reproducing means; and it comprises a slatted, relatively massive diaphragm with the several slats resonant to different frequencies, and in edgewise engagement to produce mutual damping; all as more fully hereinafter set forth and as claimed.

Loud speaker and phonograph diaphragms are usually made of thin, light material. Any great mass in a diaphragm is regarded as highly objectionable. Under application of periodic energy, any diaphragm vibrates in two ways; with forced and with free vibrations. These react upon each other in something the same complicated way as occurs with coupled electric circuits. The free vibrations are those depending upon the natural note or fundamental of the diaphragm as a whole and they are, or may be, much more energetic and damp away more slowly than the forced vibrations. This is the main reason for making diaphragms thin and light; to lower the energy ratio of free vibrations to forced vibrations. The use of paper and cloth diaphragms has the same purpose. In all ordinary diaphragms, however, there is some mass and some resonance; and there is always a fundamental of the diaphragm as a whole; this giving not only a distortion of the forced vibrations but also giving a background to the whole reproduction.

In sound reproduction, it is a well recognized fact that the response of the diaphragm to waves of various frequencies is not proportional to the amplitude of the wave. The diaphragm has its own periods of vibration and its response to impressed vibrations of frequencies near its own is exaggerated in degrees depending upon the damping. A resonating horn, where one is used, also greatly modifies waves passing through it. With any of the usual diaphragms, the resultant motion of the diaphragm and the disturbances impressed on air may be quite different from the vibrations impressed on it.

The electromagnetic reproducing units used to actuate diaphragms as a rule are quite efficient; both in radio loud speakers and in phonograph attachments. They deliver vibrations corresponding not only to the fundamental notes of an instrument but also to the overtones and harmonics on which the timbre of that instrument depends; giving them in their original ratios. So far as the reproducing unit is concerned, with an ideal diaphragm, the simultaneous reproduction of a piccolo and of a violin would give each with its own quantitative relations between fundamental and harmonics; the two instruments would be readily discernible by the ear. Actually, none of the diaphragms now in use does this. And for another thing, with the thin, light diaphragms in use there is a sensitiveness to shock excitation contributing to the noise background which radio listeners call "static".

In the present invention, I depart from the usual practice and seek to increase free vibration and decrease forced vibration. With an equal application of power, more and truer response may be had with free vibration than with forced. To avoid production of a dominant fundamental, however, I subdivide my diaphragm into a multiplicity of what may be called sub-diaphragms, each of its own period or pitch, with the several periods or notes taken together covering an octave or more. Advantageously, they cover the whole musical gamut. As free vibrations tend to continue after the application of power, my sub-diaphragms are damped by edgewise engagement with adjacent resonant areas.

In the present embodiment of my invention I make the diaphragm of parallel tuned slats, much like those of a marimba or a xylophone. Each slat has a fundamental note of its own, so that I really substitute a large number of minor fundamental notes for one major fundamental note. These tuned slats are in edgewise engagement, whereby they damp each other mutually; damping out the free vibrations when application of power ceases. Differential tuning of the slats may be accomplished by making them of different materials, of various hard and soft woods, for example, or by using different thicknesses. Both expedients may be used together. Advantageously also, the slots taper from end to end. Where only one

wood is used, this is advantageously walnut, as walnut in the present diaphragm gives a good response over the whole scale. Where two woods are used, these may be advantageously balsa and rosewood. Neither alone will give the best results but together the gamut can be well covered. The balsa slats are made thicker than the rosewood slats. The balsa slats may have a maximum thickness of 5/8 inch.

Another expedient which may be used with advantage in the present invention is the provision of node producing bridges, crossing the assemblage in various ways. Asymmetrical placement is advantageous. These bridges slope from the middle to the end, thereby, in effect, providing a multiplicity of parallel vertical rods of different tune.

A diaphragm constructed as just described has a multiplicity of areas responsive to different notes and there is always an area giving free vibrations with any musical tone. Forced oscillations also occur but these are of minor importance.

In the accompanying illustrations I have shown, more or less diagrammatically, various embodiments of the described invention.

Fig. 1 is a view in elevation of a slat type of sound board with actuating mechanism and bridge shown in dotted line, the slats having edgewise engagement;

Fig. 2 is an edge view of the dotted elements shown in Fig. 1;

Fig. 3 shows the elements in Fig. 1 from an end, illustrating the differential thicknesses of the slats;

Fig. 4 is a sectional view on a larger scale showing another embodiment of my invention;

Fig. 5 is a plan view of a form of my invention having slats secured together at meeting edges and the assemblage bridged in unsymmetrical manner;

Fig. 6 is a side view of a bridge member;

Fig. 7 is an end view showing two bridge members, and

Fig. 8 is a fragmentary view showing slats of different material.

In the showing of Fig. 1, 15 slats are illustrated. By reference to Figs. 3 and 4, it will be noted that these slats are of different thicknesses and hence, of different musical pitch. It will also be noted that these slats are more or less tapered or wedge shape. As shown in Fig. 1, these slats are secured together by end braces 10 and are further yoked by a cross bridge 11 to which is attached the pin of a diagrammatically shown actuating unit 12. It will be noted that this bridge is located nearer one end of the slat assemblage than the other.

In the structure of Figs. 5, 6, 7 and 8, the slats are cemented or glued together. As will be noted from Fig. 8, a plurality of woods of different character is used; alternating strips of balsa and of rosewood, for example. All of the strips, however, may be of the same wood and vary merely in thickness. As a general rule, where all the strips are of the same kind of wood or the same kind of material, the thickest point occurring in a slat is four times the thickness of the thinnest point occurring. The same relations may exist in using two woods of different density. If a wood is four times as dense as another wood, it is used in a quarter of the thickness in securing the same pitch. In the structure of Fig. 5, the strips are crossed by unsymmetrically placed diagonal bridges 15 and 16 and a cross bridge 17 from side to side. This bridge subdivides the whole diaphragm into six unequal triangles. For the present purposes, the bridges may be regarded as composed of assembled parallel vertical rods of unequal height, vibrating longitudinally and responding to different tones.

What I claim is:—

1. In a sound reproducing diaphragm, a panel composed of a plurality of parallel abutting, mutually damping slats of differing resonance.

2. In a sound reproducing diaphragm, a panel composed of a plurality of parallel slats of differing resonance, said slats having edge-to-edge damping engagement.

3. In a sound reproducing diaphragm, a panel composed of a plurality of parallel engaging slats of differing resonance, said panel carrying a crossing bridge member engaging all said slats.

4. In the structure of claim 1, slats tapering along their length.

5. In a sound reproducing diaphragm, a panel comprising a plurality of slats of differing resonance, said slats having edge to edge damping engagement.

6. In a sound reproducing diaphragm, a panel comprising a plurality of mutually damped slats of differing resonance, said slats being joined together along their edges, said joints preventing relative movement of the slats at their joined edges.

7. In a sound reproducing diaphragm, a panel comprising mutually damped slats of differing resonance and node producing bridges placed unsymmetrically upon said panel.

8. A sound reproducing diaphragm composed of a plurality of unsymmetrical subdiaphragms, said diaphragm comprising a plurality of slats having edge-to-edge damping engagement.

In testimony whereof, I have hereunto affixed my signature.

ADRIAAN NAGELVOORT.