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R. A. FESSENDEN

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LOUD SPEAKER APPARATUS AND METHOD

Original Filed May 21, 1924

Fig. 1.

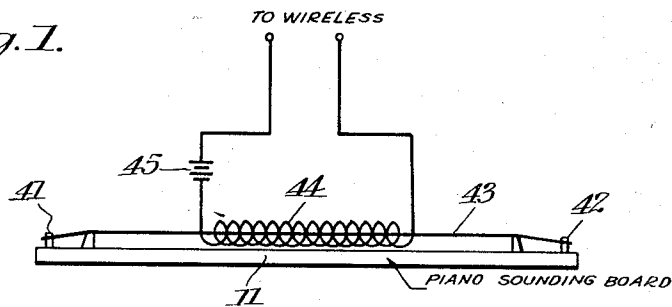


Fig. 2.

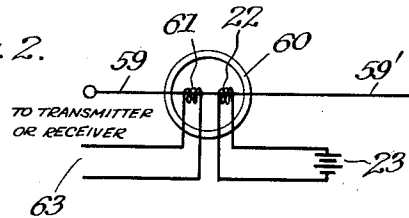
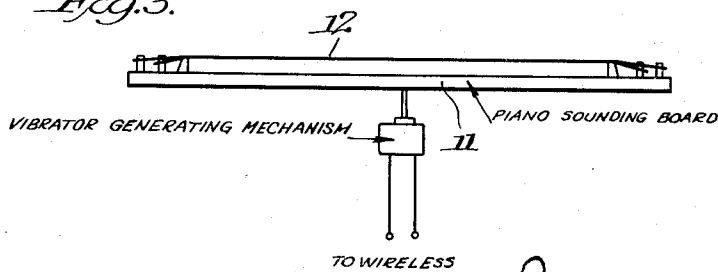


Fig. 3.



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LOUD SPEAKER APPARATUS AND METHODS

Original application filed May 21, 1924, Serial No. 714,899. Patent No. 1,854,025, dated April 12, 1932. Divided and this application filed January 6, 1927. Serial No. 159,366.

My invention relates to the reproduction of electrically transmitted sounds, and more particularly to the elimination of static and other disturbing electrical impulses, and has for its object increased efficiency in said reproduction and the elimination of said static and other disturbing electrical impulses.

Figures 1, 2 and 3, accompanying this specification, illustrate, partly diagrammatically, apparatus suitable for carrying out my invention.

Consequent on the extended use of the wireless telephone and broadcasting, four serious defects imposed attention:

(a) Great variation in intensity of reproduction with distance from the reproducer; the intensity falling off as the square of the distance.

(b) Inability of the standard loud-speakers to reproduce the lower tones of the human voice and of music.

(c) Great variation in efficiency of reproduction of different tones, ratios of ten to one, or more, being common.

(d) Inability to keep out abrupt electrical extraneous disturbances, i. e. electrical impulses which were abrupt and which it was not desired to transmit, such as static.

The first of these defects was overcome by the invention of the "sound area source", (U. S. Patent 1,213,176, June 27th, 1916), by means of which it became possible to make the intensity of reproduction substantially the same at the far end of a large hall as close up to the reproducer.

The second was overcome by the discovery and invention, as the result of considerable mathematical and experimental work, and contrary to all previous theory, that, to obtain efficient reproduction the diameter of the sound source must have a certain definite ratio to the wave length of the sounds which it was desired to reproduce efficiently. Consequently, that it was only necessary to decide what were the lowest tones which it was desired to hear, and then to make the diameter of the sound source have the required fraction of that wave length. (U. S. Patents 1,207,388, Jan. 29th, 1913, and 1,277,562, Feb. 28th, 1917), which for ordinary speech is "seven

and a half inches or more" (Spec. of 1,277,562, p. 1, l. 67.). The former standard loud speakers with diaphragms of $1\frac{1}{2}$ to 2 inches diameter have therefore, within a few years of the appreciation of this discovery, been entirely supplanted by diaphragms of 10 inches or more diameter.

The third was overcome by the discovery and invention of loud speakers having substantially a flat efficiency characteristic from the lowest audible to the highest audible tones; and which loud speakers are in part disclosed and claimed in the patent application Serial No. 714,899, filed May 21, 1924, matured as Patent No. 1,854,025, April 12, 1932, of which this is a division.

The fourth defect may be substantially eliminated by the method disclosed in the present application. It was discovered that if a plurality of resonant elements of suitable masses and suitably elastic and suitably damped and suitably chosen, were attached to an area source; for example strings strung across the face of a large diaphragm, that by proper proportioning diaphragm and resonant elements, the area source, if driven in any suitable manner, for example, by the electro-magnetic loud speaker mechanism shown in Fig. 2, or the magnetostriction loud speaker mechanism shown in Fig. 1, or in similar manner, e. g. as shown in applicant's area-source Patents 1,213,176 and 1,277,562, above referred to, the reproduction was substantially perfect.

It was also discovered that sources of this type have the further advantage that disturbing noises could be entirely cut out. Even when a violin, which has only four strings, was used as loud speaker, for an electro-phonograph, a substantially large amount of the scratching from the phonograph disc was eliminated, and by adding additional resonant elements, for example, reeds attached to the violin bridge, substantially all of the phonograph scratching could be cut out. If the number of reeds was made sufficiently numerous, such a violin loud speaker could even be made to cut out the static when used for receiving radio broadcasting.

Applicant discovered that when a piano

was used for receiving radio broadcasting, it has a sufficient number of resonant elements attached to its sounding board, i. e., the piano strings, and sufficient area to act extremely efficiently as a static eliminator in addition to its other properties of giving absolutely faithful reproduction of all sounds from the lowest to the highest, and of giving equal intensity of sound in all parts of the room. As an illustration of the efficiency of the piano as a static eliminator, for the past three summers, applicant who uses one and the members of his household and guests have never heard static or known that there was any static except on such occasions as they listened in on other types of standard apparatus to ascertain the atmospheric conditions. Reports of other tests, e. g., by the U. S. Navy, will be found in the Boston American for August 28th, 1924, with photographs of the apparatus and description of the mechanism attached to the back of the piano, and other details.

In Figure 3, 11 is the sounding board of a piano; 12, 12 are the strings of the piano. The sounding board forms the area source and may be driven in any suitable manner, e. g., by the electromagnetic loud speaker mechanism shown in Figure 2, or the magnetostriction loud speaker mechanism shown in Figure 1, or in similar manner, for example, as shown in applicant's area-source loud speaker Patents 1,213,176 and 1,277,562, above referred to. Or by a magnetostriction loud speaker mechanism like that shown in Figure 1, but comprising instead of a single wire 43, a large number of thin wires each attached to different terminals, but all actuated simultaneously by one coil, and this device made resonant by well known means so as to respond over a range of a large number of frequencies. Or by any of the mechanisms well known in the art, such as that described as attached to the back of the sounding board of the piano in applicant's article in the Boston American Aug. 28th, 1924.

The driving mechanism may be attached to any suitable part of the sounding board of the piano in any suitable manner, for example, by cement, but as the method of attachment and the method of driving are not claimed herein, further particulars will not be necessary as suitable means are well known in the art.

Figure 1 shows the attachment of the well known magnetostriction driving apparatus to a piano sounding board, and 43 a nickel or iron wire attached to tuning pins 41, 42, fastened to the piano sounding board 11, and 44 is the magnetizing coil leading through the battery cell 45 to the terminals of the secondary of the receiving set or telephone line.

Figure 2 shows another well known type of loud speaker electromechanism where the wires 59, 59' are preferably of soft iron or

nickel and are screwed into the circular spring 60 of magnetic material so as to leave a small air gap between them, as shown. 22, 23 are a magnetizing coil and a source of current, and 61 is a coil connected as shown to leads 63 going to the transmitter or receiver. 62 is a small ball used as an inertia to oppose the pull on the wire when the two wires 59, 59' are retracted together by the action of the currents flowing in the coil 61, as shown. Or, when desired, in place of using the small ball on the wire, the wire may, as is customary with this type of telephone mechanism, be fastened to a post or other support.

Which particular method of drive is used will depend upon circumstances. In the arrangement shown in Figure 1, the change in length of the wire 43 caused by the magnetostrictive effect of the received telephonic currents flowing through the coil 44 bends the entire sounding board in and out thereby causing the whole sounding board to act as a unitary large diaphragm. Also by employing a number of such wires 43 and suitably arranging them as shown in the parent application, the piano loud speaker can be made so as to have no detrimental selective resonance.

What I claim is:

1. In the art of reproducing electrically transmitted sounds, the method of eliminating the effect of static and other disturbing electrical impulses by causing the transmitted impulses, both sound producing and disturbing, to actuate the sounding board of a piano as a loud speaker; whereby the disturbing impulses are reproduced with much less relative intensity than the sound producing impulses.

2. In the art of reproducing sounds transmitted electrically, the method of eliminating the effects of static and other disturbing electrical impulses which comprises actuating, by the received impulses, the sounding board of a piano as a loud speaker.

3. In the art of reproducing sounds transmitted electrically, the method of reducing the ratio of the effects of static and other disturbing impulses to those for producing the sounds which it is desired to reproduce; comprising actuating by the received impulses, a loud speaker electromechanism attached to the sound board of a piano.

4. The method of reproducing electrically transmitted sounds which consists in vibrating by the electrically transmitted impulses the sound board of a piano and transmitting said vibrations from said piano sound board to the air, whereby a loud speaker action of said piano sound board is produced.

5. The method of reproducing electrically transmitted sounds which consists in electromagnetically producing vibrations in a piano sound board responsive to the transmitted electrical impulses, and transmitting said vi-

- brations from the piano sound board to the air.
6. A loud speaker comprising a piano sound board and electromagnetic means responsive to the transmitted electrical current impulses for actuating by direct operative contact said sound board.
7. A loud speaker comprising a piano sound board and loud speaker electrical mechanism in operative contact with said sound board for actuating the same.
8. A loud speaker comprising a piano sound board and loud speaker electrical mechanism attached to said sound board for actuating the same.
9. A loud speaker comprising a loud speaker electrical mechanism and a piano sound board, said loud speaker electrical mechanism actuating said piano sound board by direct mechanical operative contact therewith.
10. An electrically operated loud-speaker unit comprising a vibratable element, and means for attaching the vibratable element of said loud-speaker unit directly to the sounding board of a piano.
11. A piano comprising a sounding board and strings attached to one side of said board capable of producing a plurality of chromatic scales, an electrically operated loud-speaker unit having a vibratable element, and means for connecting said vibratable element directly to said sounding board to effect vibration of the board, the vibration of said board setting said strings into vibration.
12. A piano comprising a sounding board and strings attached to said sounding board capable of producing a plurality of chromatic scales, a loud-speaker unit comprising a vibratable element mounted at one side of the board and arranged so that the impulses of said vibratable element will be directly transmitted to said sounding board to set the sounding board into vibration, the said vibration of said board setting the strings into vibration.
13. A piano comprising a sounding board and a plurality of strings vibratable at their natural frequencies over substantially the entire range of audible sounds, and a loud-speaker vibrator mechanism connected to said sounding board and adapted to vibrate said sounding board and strings over substantially all of said audible range.
14. An area source of sound and a plurality of resonant elements connected thereto, resonant at their natural frequencies over substantially the range of response desired, and a vibratable mechanism connected to said sounding board and adapted to vibrate said sounding board over substantially all of the desired range, and thereby to set in vibration the said resonant elements.
15. A sound producing device comprising an area source, a plurality of magnetostriction wires, means for attaching the ends of said wires to said source and magnetostrictive means for vibrating the same.
16. A sound producing device comprising an area source, a plurality of magnetostriction wires, means for attaching the ends of said wires to said source and an electric coil in operative relation to said wires.
17. A sound producing device comprising a piano sounding board, a plurality of magnetostriction wires stretched across said board and means for energizing the same.

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