

A. N. PIERMAN.
SOUND REPRODUCER.
APPLICATION FILED SEPT. 13, 1909

1,024,696.

Patented Apr. 30, 1912.

3 SHEETS-SHEET 1.

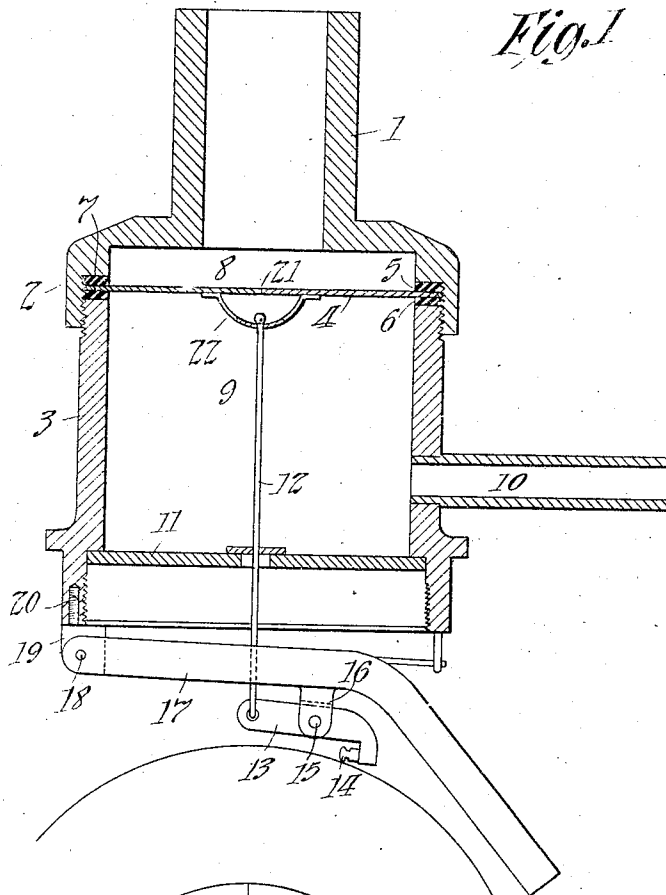
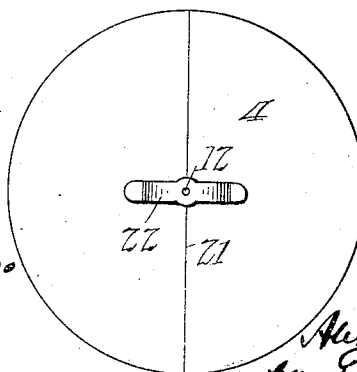


Fig. 2



Witnesses:
Frank D. Lewis
Dyer Smith

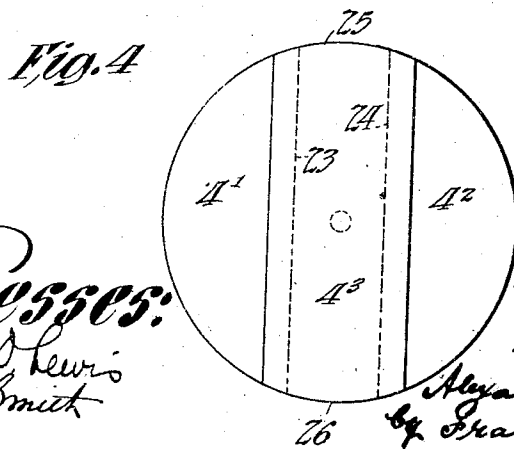
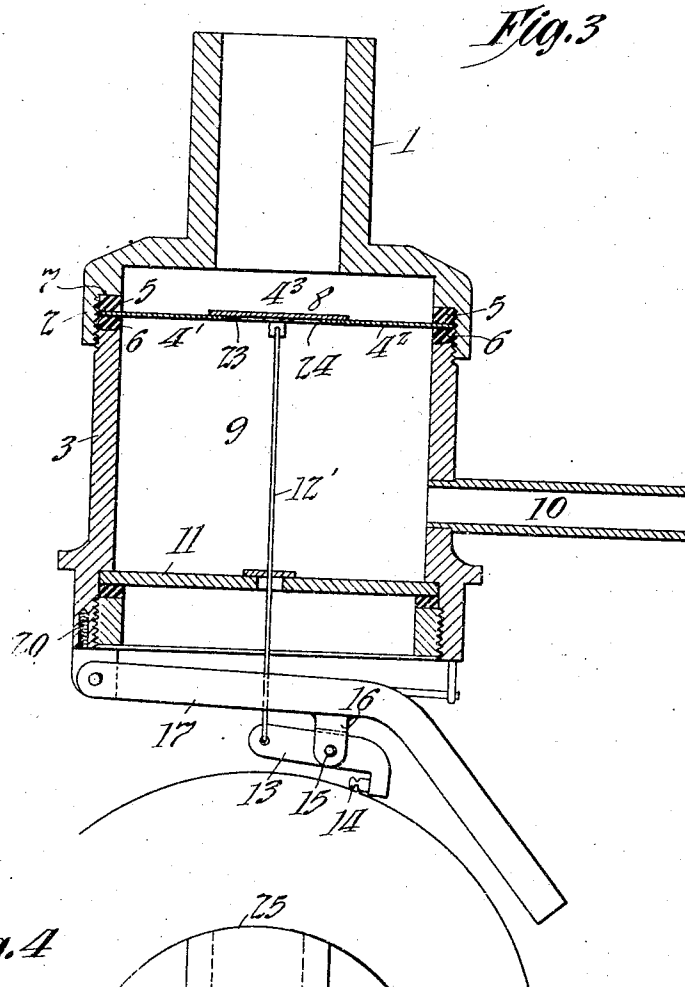
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Alexander A. Pierman
by Frank L. Pierman
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3 SHEETS—SHEET 3.

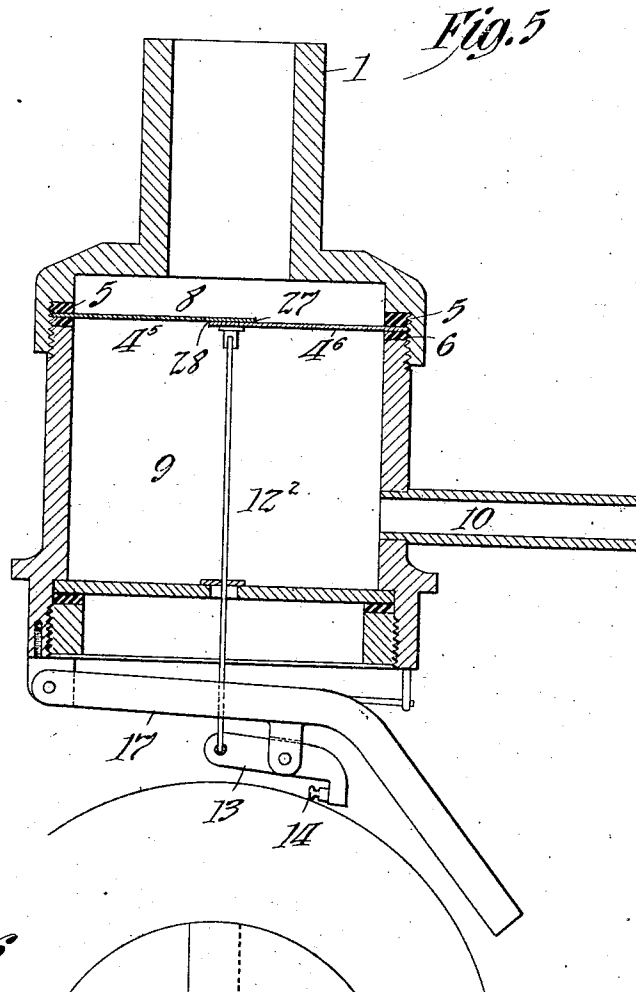
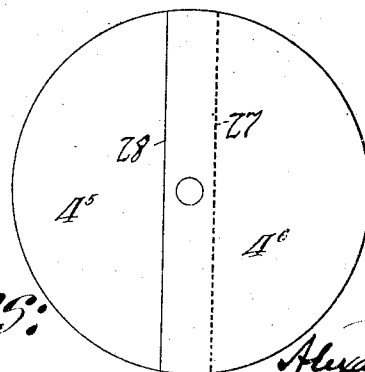


Fig. 6



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UNITED STATES PATENT OFFICE.

ALEXANDER N. PIERMAN, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THOMAS A. EDISON, INCORPORATED, OF WEST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

SOUND-REPRODUCER.

1,024,696

Specification of Letters Patent.

Patented Apr. 30, 1912.

Application filed September 13, 1909. Serial No. 517,510.

To all whom it may concern:

Be it known that I, ALEXANDER N. PIERMAN, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have made a certain new and useful Invention in Sound-Reproducers, of which the following is a description.

My invention relates to phonograph reproducers of the pneumatic type, or, generally speaking, of the type in which undulations corresponding to sound waves are impressed upon a current of any suitable moving fluid by the operation of a suitable valve through which the fluid is allowed or caused to pass, the valve being operated in accordance with the sound waves as by connection with a reproducing stylus tracking a record groove.

The improvements covered by my present application reside chiefly in the construction of the valve through which the air or other moving fluid is caused to pass in setting up the undulations corresponding to the sound waves.

The chief object of my invention is the production of a sound reproducer having a vibratory member which serves to set up vibrations corresponding to sound waves in the well known manner when the device is operated under atmospheric pressure, that is to say, when a moving fluid is not progressed therethrough, the vibratory member or diaphragm being so formed as to act as a valve under abnormal or forced fluid pressure, that is to say, when a current of air or other fluid passes through the reproducer, the valve, which is then formed by the vibratory member, serving to set up undulations in the current of fluid passing therethrough in accordance with the sound waves to be reproduced.

Other objects of my invention include the production of a diaphragm so formed as to be capable of vibration in accordance with sound vibrations under atmospheric pressure and capable of opening more or less in accordance with sound vibrations to form a port for the passage of fluid therethrough under forced fluid pressure, and the construction and combinations of parts suit-

able for the production of the objects above enumerated.

These various objects may be attained by a number of constructions which are herein after described and specifically claimed.

Reference is hereby made to the accompanying drawings forming part of this specification, and in which—

Figure 1 is a side elevation, partly in section, of a sound reproducer embodying my form of my invention; Fig. 2 is a bottom plan view of the diaphragm or vibratory member employed in the same; Fig. 3 is a side elevation, partly in section, of a reproducer embodying a second form of my device, Fig. 4 representing a top plan view of the vibratory member employed in the same; and Figs. 5 and 6 represent respectively a side elevation, partly in section, of a reproducer embodying a third form of my device, and a bottom plan view of the vibratory member employed in the same.

Referring to the drawings and more particularly to Figs. 1 and 2, the sound reproducer 1 is provided with a depending flange 2, within which is screw threaded the cylinder 3, the diaphragm or vibratory member 4 being clamped between gaskets 5 and 6, gasket 5 contacting shoulder 7 formed in flange 2 of reproducer body 1, cylinder 3 being screwed up within flange 2 to bind the parts firmly together. Diaphragm 4 divides the interior of the sound box into two chambers 8 and 9. Air under pressure may be forced within chamber 9 by means of air duct 10 although it is obvious that suction might be employed if desired in place of pressure for causing the passage of the moving fluid through the reproducer. Chamber 9 is closed at its lower end by means of closure 11 through which passes link 12 which is secured to the rear end of stylus lever 13 which carries stylus 14, and is pivotally mounted at 15 to lugs 16 secured to or integral with floating weight 17, which is pivoted at 18 to pivot block 19 which is secured to the lower end of cylinder 3 by any suitable means, as the vertical screw 20. The diaphragm 4 is preferably formed of a flat plate of glass and is slit transversely and diametrically as shown at

21. This slit is formed in the diaphragm after the latter has been secured in place within the reproducer by means of a diamond or other suitable cutting agent, the slit or crack being closed when the diaphragm is at rest. As shown in Fig. 2, the slit or crack 21 extends across the entire diaphragm. The link 12 is connected to the diaphragm on either side of the crack or slit, as indicated at 22.

In the operation of the device, the diaphragm 4 may be vibrated as a simple diaphragm by connection through link 12 with stylus 14 whenever it is desired to reproduce in the ordinary manner, that is, without the passage of a moving fluid through the reproducer. In this case, the crack 21 remains quite tight and does not interfere perceptibly with the vibration of the diaphragm or with the reproduction of sound caused by the vibration of the same. Whenever it is desired to operate the device as a pneumatic sound box, however, the pressure of air or other fluid on the lower side of the diaphragm tends to flex the diaphragm upward, opening slightly crack 21 and affording a passageway therethrough for the moving fluid. This opening is varied more or less in accordance with the sound waves to be reproduced by the connection between the diaphragm and the stylus above described. Thus, undulations are impressed upon the fluid moving through slit 21 corresponding to sound vibrations to be reproduced.

Referring more particularly to Figs. 3 and 4 of the drawings, the vibratory member or diaphragm is formed in the following manner:—Elastic plates 4' and 4² are supported from opposite sides of the sound box between gaskets 5 and 6, the parts being secured in place between shoulder 7 of sound box 1 and cylinder 3 in the same manner as described in connection with Figs. 1 and 2. Elastic plates 4' and 4² are each sections or segments of a diaphragm having inner unsupported edges constituting chords of the circle less than the diameter, these unsupported edges 23 and 24 being preferably parallel. A third elastic plate 4³ rests upon the unsupported edges 23 and 24 of plates 4' and 4² overlapping said edges to cover the opening therebetween. This plate 4³ is of elastic material, preferably the same of which plates 4' and 4² are formed, and is bounded preferably by chords of the circle parallel to edges 23 and 24 of plates 4' and 4² and slightly shorter than chords 23 and 24 since the plate 4³ overlaps both plates 4' and 4². Plate 4³ is bounded at its edges 25 and 26 by arcs of the circle which form the supported periphery of plates 4' and 4², plate 4³ being held at these edges by gasket 5. The link 12' is connected to plate 4³ at its central point, as indicated, link 12' being connected

to stylus 14 in the manner described in connection with Figs. 1 and 2.

In the operation of this device when the reproducer is operated as a simple reproducer without the passage of fluid therethrough, elastic plates 4', 4² and 4³ vibrate together to form a simple reproducer the vibrations of which cause the desired reproduction. In this operation the elasticity of plates 4' and 4² cause them to follow the plate 4³ in its upward movement when stylus 14 descends within depressions in the record, plate 4³ forcing plates 4' and 4² downward when plate 4³ descends in obedience to the passage of stylus 14 over elevations in the record. When, however, the device is used as a pneumatic reproducer, pressure of the moving fluid upon the lower surface of plate 4³ causes a slight opening between plate 4³ and plates 4' and 4² along edges 23 and 24. The amount of this opening varies with the movements of stylus 14 along the record groove and the undulations impressed upon the current moving through the passages formed along edges 23 and 24 vary accordingly.

Referring more particularly to Figs. 5 and 6 of the drawings, the diaphragm or vibrating body in this form of my invention is formed of two plates 4⁵ and 4⁶ of elastic material, which are supported in the sound box on opposite sides thereof between the gaskets 5 and 6. These plates 4⁵ and 4⁶ are similar to plates 4' and 4² in the last described form of my invention, except that one of the plates, as 4⁵, overlaps the other, as 4⁶, at its inner or unsupported edge. That is to say, the plates 4⁵ and 4⁶ comprise segments of a circle supported at the periphery between gaskets 5 and 6 and bounded at their inner unsupported edges 27 and 28 by chords of the circle which are preferably parallel, the plates 4⁵ and 4⁶ extending across the center of the circle. The link 12², which is connected to the stylus lever 13 which bears stylus 14 as in the previous figures, is secured to the lower side of plate 4⁶ near the edge 28 thereof. The overlapping edge of plate 4⁵ lies snugly upon the outer surface of plate 4⁶, the two plates being mounted in parallel relation, and when the reproducer is operated without the flow of a current of air or other fluid therethrough, the plates 4⁵ and 4⁶ vibrate together as a simple diaphragm, the elasticity of plate 4⁵ causing it to follow the plate 4⁶ downwardly when the latter is vibrated downwardly, because of the movement of stylus 14 over elevations in the sound record. When, however, the device is operated as a pneumatic reproducer, the pressure of moving fluid forced into chamber 9 from pipe 10 upon the lower surface of plate 4⁵ causes the upward flexure of plate 4⁵ to a sufficient extent to permit the

passage of air across edge 28 from chamber 9 into chamber 8 through an opening between the two plates 4^s and 4^e, the amount of which opening varies in accordance with the sound vibrations to be reproduced.

Having now described my invention, what I claim and desire to protect by Letters Patent is as follows:

1. In a sound reproducer, the combination with a sound box of a flat divided diaphragm supported within the same, and means for vibrating said diaphragm in accordance with sound vibrations under conditions of normal pressure and for causing said diaphragm to open more or less to permit the passage of fluid therethrough in accordance with sound vibrations, under conditions of abnormal pressure, substantially as described.

2. In a sound reproducer, a flat diaphragm capable of vibration in accordance with sound vibrations under atmospheric pressure, and capable of opening more or less in accordance with sound vibrations to form a port for the passage of fluid therethrough under forced fluid pressure, substantially as described.

3. In a sound reproducer, a flat diaphragm formed of a plurality of parts adapted to act as a simple diaphragm under normal atmospheric pressure, but to act as a valve under abnormal or forced fluid pressure, substantially as described.

4. In a sound reproducer, the combination with a sound box of a diaphragm of elastic material supported within the same and formed of a plurality of parts supported and fitting together in contact throughout their adjacent edges so as to vibrate as a diaphragm under normal pressure, but said parts being adapted to separate to form a port opening under forced pressure, and means for vibrating said diaphragm under normal pressure or causing said parts to separate more or less under forced fluid pressure, in either case in accordance with sound vibrations, substantially as described.

5. In a sound reproducer, the combination with a sound box of a diaphragm supported within and dividing the same into two chambers, said diaphragm being of elastic material and being slit across the same, and means for flexing said diaphragm in accordance with sound vibrations to cause said diaphragm to open at said slit to a greater or less extent, said diaphragm when at rest having no openings therein, substantially as described.

6. In a sound reproducer, the combination with a sound box of a diaphragm supported within the same, said diaphragm being of elastic material and slit transversely, said slit being closed when said diaphragm is in normal position, and means for flexing said diaphragm in accordance with sound vibra-

tions to cause said slit to open to a greater or less extent to form a passageway for a fluid passing therethrough, substantially as described.

7. In a sound reproducer, the combination with a sound box of a diaphragm supported within and dividing the same into two chambers, said diaphragm being of elastic material and being slit transversely, said slit being closed when said diaphragm is in normal position, means for introducing fluid under pressure into one of said chambers, and means for flexing said diaphragm in accordance with sound vibrations to cause said slit to open to a greater or less extent to throw said fluid passing through said slit into vibrations corresponding to said sound vibrations, substantially as described.

8. In a sound reproducer, a sound box, a diaphragm supported within said box, said diaphragm being slit transversely and so held that said slit is normally closed, but is adapted to be opened slightly on flexure of said diaphragm, substantially as described.

9. In a sound reproducer, the combination with a sound box of a diaphragm supported within and dividing the same into two chambers, said diaphragm being of elastic material and being slit transversely, said slit being closed when said diaphragm is in normal position, means for introducing fluid under pressure into one of said chambers, a pivoted stylus lever and stylus carried thereby, and a connection from said lever to said diaphragm attached to the latter adjacent said slit, substantially as described.

10. In a sound reproducer, the combination with a sound box of a diaphragm supported within and dividing the same into two chambers, said diaphragm being of elastic material and being composed of a plurality of members so held and positioned as to prevent communication between said chambers when at rest, and to vibrate as a diaphragm when connected under normal pressure to a reproducing stylus, but adapted to separate and allow the passage of fluid between said chambers in greater or less degree when thus connected under forced fluid pressure, means for introducing fluid under pressure into one of said chambers, a stylus lever and stylus carried thereby, and connections from said lever to said diaphragm, substantially as described.

11. In a sound reproducer, the combination with a sound box of elastic means dividing the same into two chambers, means for introducing fluid under pressure into one of said chambers, said elastic means being normally closed but adapted to open under forced pressure to form a passageway therethrough, and means for reproducing sound by vibrating said elastic means under normal pressure or by causing said

elastic means to open more or less under forced pressure and thus setting up vibrations in the fluid passing therethrough, in accordance with sound vibrations, substantially as described.

12. In a sound reproducer, the combination with a sound box, of a flat dividing diaphragm supported within the same, and means for vibrating said diaphragm in accordance with sound vibrations under conditions of normal pressure, and for causing said diaphragm to open more or less to permit the passage of fluid therethrough in accordance with sound vibrations under conditions of abnormal pressure, said diaphragm when at rest having no openings therein, substantially as described.

13. In a sound reproducer, a flat diaphragm capable of vibration in accordance with sound vibrations under atmospheric pressure, and capable of opening more or less in accordance with sound vibrations to

form a port for the passage of fluid therethrough under forced fluid pressure, said diaphragm when at rest having no openings or ports therein, substantially as described.

14. In a sound reproducer, in combination with a sound box, of a diaphragm supported within and dividing the same into two chambers, said diaphragm being of elastic material and being slit entirely across the same, and means for flexing said diaphragm in accordance with sound vibrations to cause said diaphragm to open at said slit to a greater or less extent, said diaphragm when at rest having no openings therein, substantially as described.

This specification signed and witnessed this 10th day of September 1909.

ALEXANDER N. PIERMAN.

Witnesses:

DYER SMITH,
JOHN M. CANFIELD.