(No Model.) 2 Sheets—Sheet 1.

W. BRUENING.

TELEPHONY.

No. 485,859. Patented Nov. 8, 1892.

Fig. 1

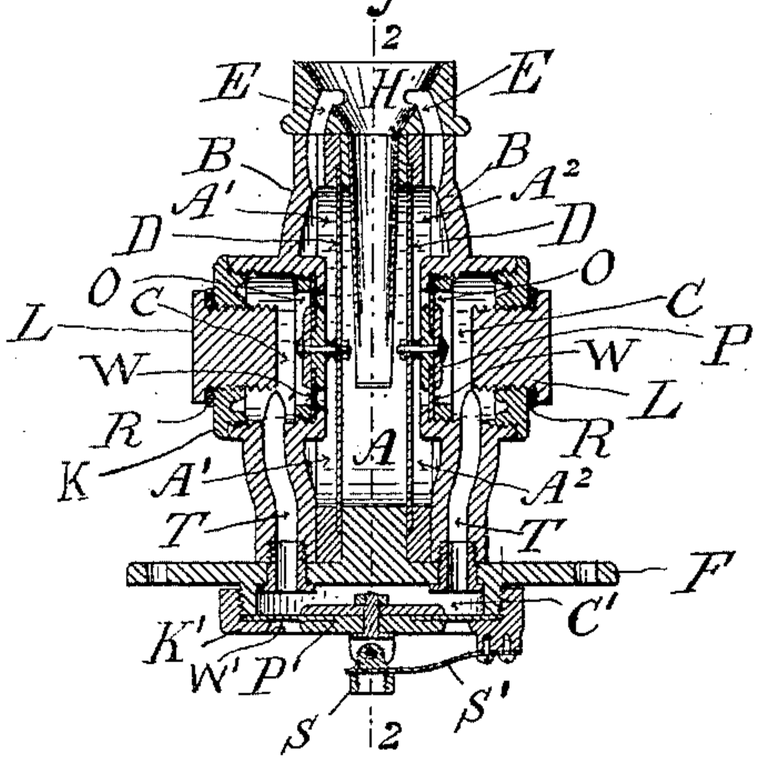


Fig. 3

Fig. 2

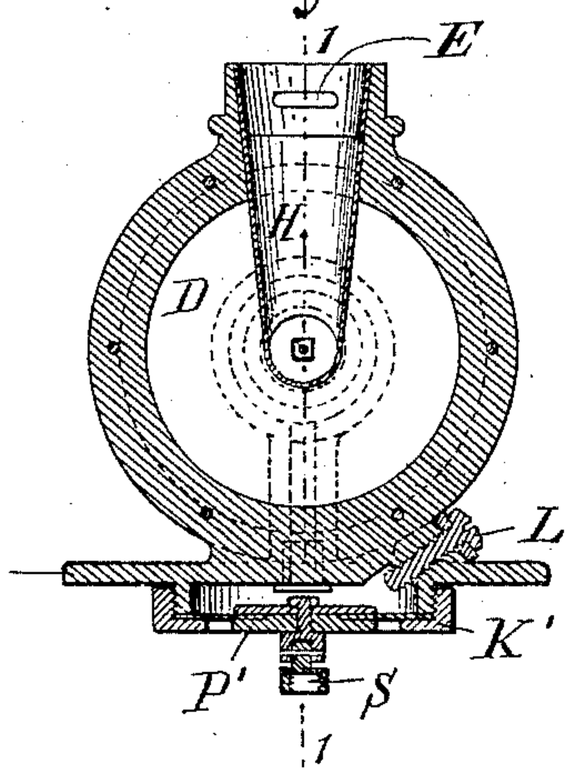


Fig. 8.

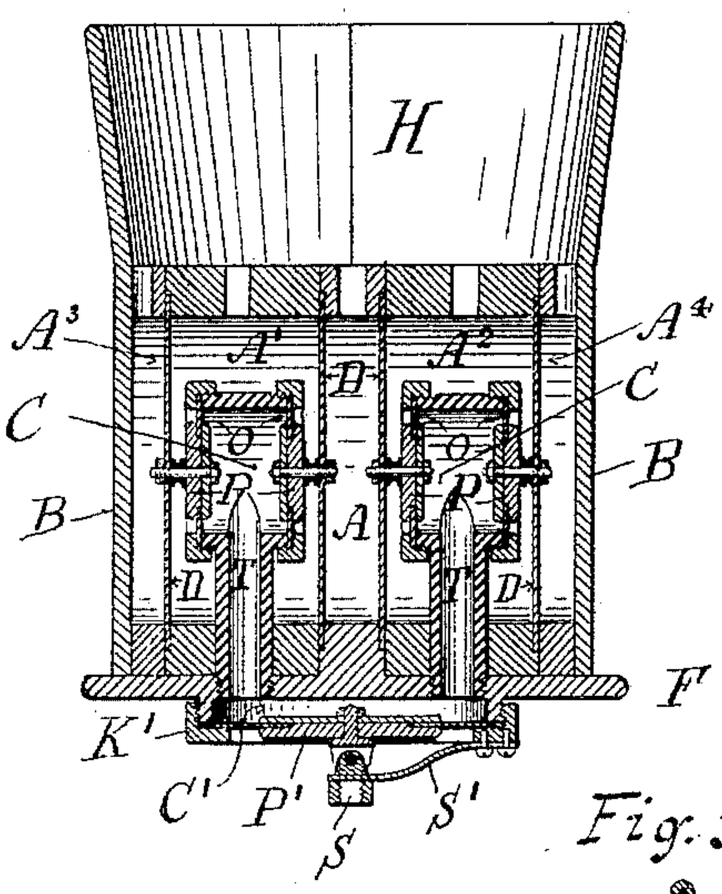


Fig. 4.

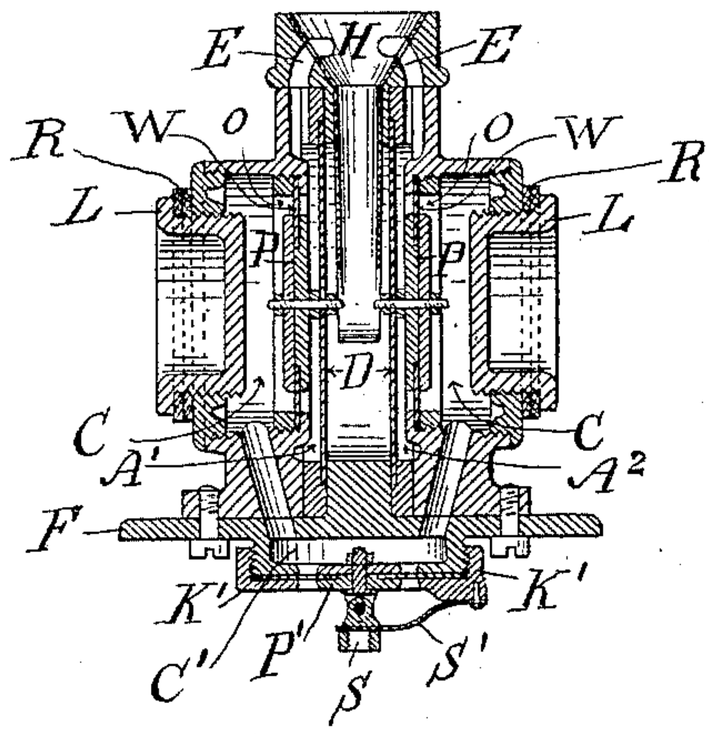
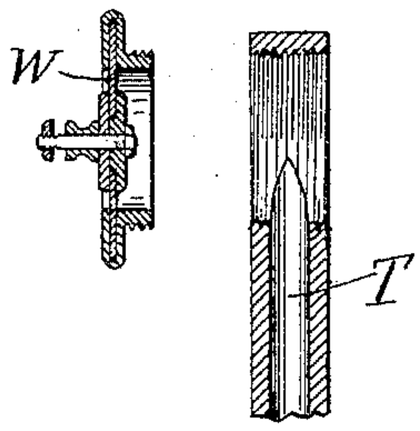


Fig. 5 Fig. 6.



William Bruening
Inventor

Witnesses
Chas Hanimann
Edward S. Berrall.

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W. BRUENING.

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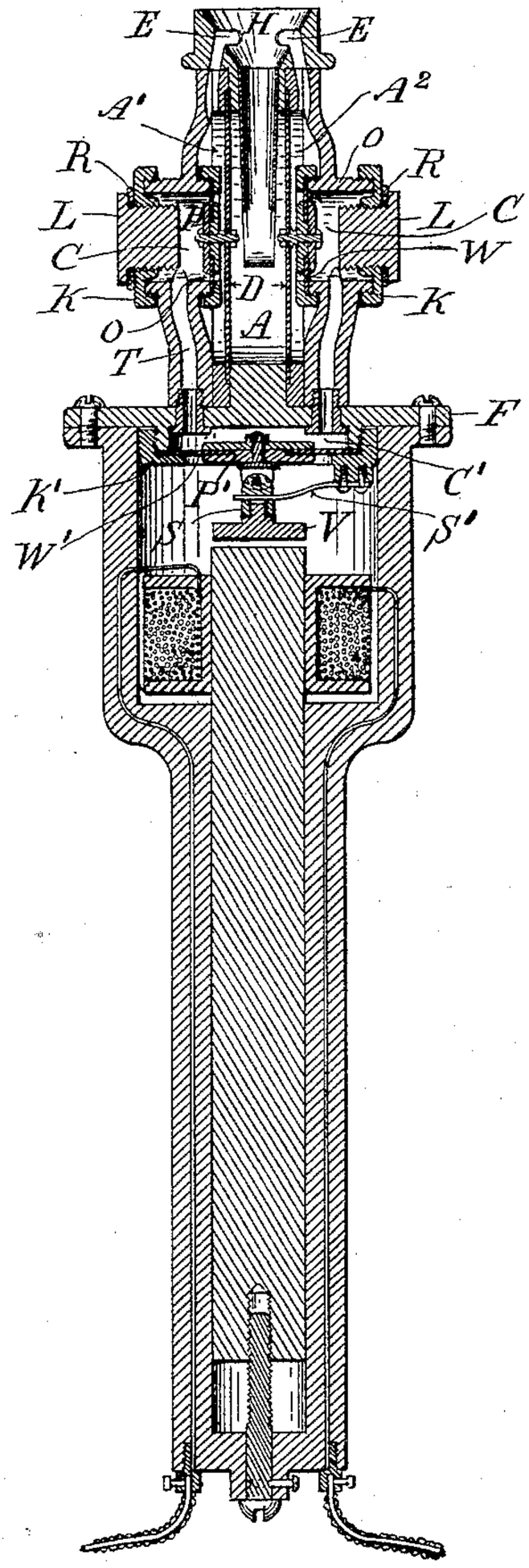
Fig. 7.



Witnesses
Chas. Hanimann
Edward S. Berrall

William Bruening
Inventor

UNITED STATES PATENT OFFICE.

WILLIAM BRUENING, OF EAST ORANGE, NEW JERSEY.

TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 485,859, dated November 8, 1892.

Application filed August 1, 1891. Serial No. 401,373. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM BRUENING, a citizen of the United States, residing in the township of East Orange, in the county of Essex and State of New Jersey, have invented a new and useful Improvement in Apparatus for Transmitting Sound-Vibrations, of which the following is a specification.

My invention relates to an apparatus for transmitting sonorous vibrations to or from a telephone, a phonograph, or other acoustic instrument, and has for its object to provide a sensible and efficient apparatus for transmitting sound, whereby the force of sound-vibrations does a greater amount of work in exerting stress and to make sound reproduced from the aforesaid instruments more audible and distinct; and it consists in balancing three or more movable inflexible surfaces or dashers in contact with a confined fluid by means of externally-applied tension, in regulating such tension by variable pressure upon the fluid, in attaching such dashers to the point of greatest resilience of two or more diaphragms, both surfaces of which vibrate in communication with the surrounding air, in arranging the diaphragms and dashers to make the apparatus reversible, and in improvements which will further sufficiently appear in connection with the further description of the apparatus or art and method of operation to follow and in the claims annexed hereto.

I attain the objects of my invention by the means set forth and described in this specification, and illustrated in the accompanying two sheets of drawings, in which—

Figure 1 is a vertical sectional view cut on the line 1 1, Fig. 2, and shows in sectional view the sound-conveyer, diaphragms, dashers, air-spaces, chambers, tension-spring, and other associated parts. Fig. 2 is a similar view cut on the line 2 2, Fig. 1, showing in sectional view the sound-conveyer, the central air-space in which it rests, and the lower air-chamber and dasher with the associated parts. Fig. 3 is a vertical sectional view showing four diaphragms arranged to concentrate their action upon the single diaphragm or vibrating body. Figs. 4, 5, and 6 represent detail parts; and Fig. 7 is a vertical sectional view of the apparatus connected with a telephone. Fig. 8 shows the dashers P P′ in reversed proportions.

Similar letters represent similar parts throughout the figures.

B is a frame consisting of a rigid hollow vessel of any suitable form or construction, having three or more openings in its walls, which are hermetically closed by movable inflexible surfaces and their flexible connections, which I term "dashers." The vessel contains a fluid which may be either liquid or gaseous, and is provided with preferably-circular frames for holding two or more diaphragms.

In the drawings the vessel containing the fluid is represented by the walls of the chambers C C and C′ and the connecting-tubes T T. The openings O of the chambers C C are closed by dashers P P, which are constructed of a plate or plates of rigid material, and are connected at their edges with the walls of the chambers by means of a narrow band of rubber, cloth, or other flexible fabric, (shown at W W,) and the opening of the chamber C′ is closed by the screw-cap K′, which carries the dasher P′ and its flexible connecting material W′, and which is made and attached in the same manner as the dashers P.

D D are diaphragms of any usual construction or material, and are held at their edges by washers or frames in the frame B, with air-spaces A A′ A^2 on both sides, which communicate with the outer air through openings in the frame, as H and E E in Fig. 1, which form the mouth of a sound-conveyer provided externally with a shoulder or flange to support a horn or tube. The sound-conveyer may be extended into the air-space between the diaphragms, with openings to face and direct the sound on the center of the diaphragms, as shown at A, Figs. 1 and 2; but such is not an absolute necessity. Each dasher P is attached to the center or point of greatest resilience of a diaphragm D by a pin or other suitable means, and is operated by or in turn operates the diaphragm, and the dasher P′ is provided with ears, by which it is movably attached to a spring S′ by means of a lug thereon, and secured by a pin passing through a hole in the ears and lug, and the other end of the spring is secured to the screw-cap K′. The spring S′ is provided

with a socket S for attaching a style S^2 of a phonograph, or an armature V, or an electrode of a telephone, or a wire or other sound-conductor of an acoustic instrument. The spring S′ exerts an outward tension on the dasher P′, and such tension is proportioned to that exerted on the dashers P by the diaphragms D, so that all the dashers in contact with the confined fluid are in equipoise. The tension is regulated by a screw-plug L, which penetrates the wall of the vessel at any feasible point and bears upon the fluid and is located in Fig. 1 in the screw-cap K, which closes the other side of the chamber C, and is provided with a washer or packing to prevent the escape of the fluid. The tension may be diminished by turning the plug L forward into the chamber, by which the dashers are pressed outwardly, or the tension is increased by reversing the motion of the plug L, whereby the atmospheric pressure will cause the dashers to move inwardly and draw the diaphragms D D and the spring S′ toward them. By these means promptness and delicacy of action of the apparatus are obtained. The chambers C C and C′ and the connecting-tubes T T are filled with air, water, or mercury, or other suitable fluid. I prefer a liquid on account of its density and relative non-compressibility, as it prevents a waste of energy. The flange F is used to secure the apparatus in place, as shown in Fig. 7, in connection with a telephone, and may be used to secure the apparatus on the diaphragm-holder of the phonograph in my application, Serial No. 377,724, filed January 14, 1891.

In Fig. 3 are shown four diaphragms D, with air-spaces on each side thereof, connecting with the outer air through openings in the frame forming the mouth of the sound-conveyer, and four dashers P, attached to the centers of the diaphragms and located on opposite sides of the chambers C, while the other arrangements are similar to those already described in Figs. 1 and 2.

In operation when sound is conveyed into the air-spaces on either side of the diaphragms D by means of an attached horn or tube, or directly through the mouth of the sound-conveyer, it causes the vibration of the diaphragms, which vibrations are transmitted from their points of greatest resilience to the dashers P connected therewith. Sundry forces so exerted are compounded and transmitted by means of the confined fluid to the dasher P′, whence the force is exerted in increased effective stress by reason of the diminished resistance and allows the use of a stronger magnet, or exerts greater pressure on a carbon or other electrode of an electric circuit in a telephone, or causes a style to bear with greater pressure on a recording-surface in a phonograph, or exerts greater stress on the sound-conductor of an acoustic instrument. When the apparatus is used to reproduce sound in connection with any of the aforesaid instruments, the force of the vibrations transmitted to the dasher P′ is resolved and transmitted by means of the confined fluid to sundry dashers P, which exert the forces in directions toward each other and upon the points of least resistance of sundry diaphragms D, which impart their vibrations to the air in contact with each of their surfaces and thence to the outer air, whereby a more audible and distinct sound is produced. Heretofore when a confined fluid was used to transmit sound-vibrations from or to movable surfaces in contact with such fluid one surface of a flexible diaphragm was placed in contact with the fluid and the other surface was exposed to the air, and the air caused the vibration of or was vibrated by such surface, the force of the vibrations was exerted on parts of such flexible surface which offered more or less resistance by its rigidity near its periphery, and was therefore more or less neutralized, and but a small proportion of the expended energy was exerted in actual stress on or by the fluid. In this invention, in using an inflexible balanced surface or dasher in contact with the intermediate confined fluid the whole surface of such dasher will move and bear on the fluid according to the amplitude and stress of the most resilient part of the diaphragm to which it is attached, and the vibrations are transmitted by means of the fluid and cause a corresponding movement of the whole inflexible surface of the other dasher or dashers in contact therewith, whereby the effective proportion of force exerted by the vibrations is considerably increased.

In Figs. 1, 2, and 3 the apparatus shown is reversible, and the amplitude of the vibrations is preserved by making the area of the dasher or dashers from which the vibrations are transmitted equal to that to which they are transmitted. As is well known, the power of stress may be increased at a loss of amplitude, and is shown in Fig. 8, in which the area of the surface of the dasher P′ is relatively smaller than that of the combined areas of the dashers P. This apparatus is used solely for reproducing sound, while in an apparatus for transmitting or recording sound these conditions may be reversed. The apparatus herein shown is made with a view to compactness; but when such is not deemed essential the diaphragms need not necessarily be parallel, but may be arranged in a plane or approximately form a hollow or concave surface, and the vessel containing the confined fluid is shaped accordingly. I do not restrict myself to the means herein shown of confining the diaphragms, and I might also use the dashers P to take the place of diaphragms; but I prefer the arrangement shown as being more convenient of construction. It may be desirable when the apparatus is used in connection with an electrode or with an electrically-heated style to insulate the spring S′, and in that case the screw-cap K′ and the dasher P′ and its ears may be made of hard rubber or other non-conducting material.

Fig. 4 represents a style of a phonograph exaggerated in size provided with a threaded nipple for engagement with the socket S.

Fig. 5 shows the construction of a dasher and means whereby it may be secured in its chamber and to the diaphragm. The flexible material is secured at its outer edges in a threaded cap or button by spinning or folding the edges of the button over those of the material, or a separate strip or ring may be turned in under the shoulder of the button and cover and secure the edges of the flexible material, and the inner edge thereof is held between two plates of inflexible material, which form the dasher and are secured by a pin passing through their center, which also secures the diaphragm by means of shoulders and a thread and nut, or in any other convenient manner, and it is desirable that the exposed part of the flexible material shall be no wider than is consistent with the free movement of the dasher. Fig. 6 shows the chamber C and part of the connecting-tube, as represented in Fig. 3, arranged to receive the screw-cap and the dasher from opposite sides. The tubes are secured in the chamber C′ by a short threaded tube or bushing engaging with an internal thread on the tube T and packing at the joints to make them air-tight or by soldering or cementing them in place. As the lines of separation are clearly shown in the drawings, it will not be necessary to give a further detailed account of the construction of the apparatus.

The term "dasher," as hereinafter used, signifies an inflexible surface, held movably in contact with a hermetically-sealed fluid for transmitting sound-vibrations by means of such fluid to or from a similar surface or surfaces in contact with such fluid.

I claim as my invention—

1. An apparatus for transmitting sound-vibrations, consisting of a closed hollow vessel containing a fluid and provided with dashers, which are held movably in contact with said fluid, one of which said dashers is provided with a spring and each of all other said dashers is provided with a diaphragm.

2. In a reversible apparatus for transmitting sound-vibrations, a confined fluid, in combination with three or more dashers held movably in contact therewith and two or more parallel diaphragms.

3. In an apparatus for transmitting sound-vibrations, a confined fluid, in combination with three or more dashers held movably in contact therewith and two or more diaphragms.

4. In an apparatus for transmitting sound-vibrations, which consists of a closed hollow vessel containing fluid and provided with dashers, which are held movably in contact with said fluid and in equipoise by outward tension, a plug which bears on said fluid to regulate such tension.

5. In an apparatus for transmitting sound-vibrations, a confined fluid, in combination with three or more dashers held movably in contact therewith, two or more diaphragms, a spring, and a socket or its equivalent for securing the operative part or attachment of a sound-conveying instrument thereto.

WILLIAM BRUENING.

Witnesses:
JAMES A. SKILTON,
EDWARD S. BERRALL.