C. H. BILLINGS & M. J. MAXWELL.

Mechanical Telephone.

No. 218,707. Patented Aug. 19, 1879.

Fig. 1

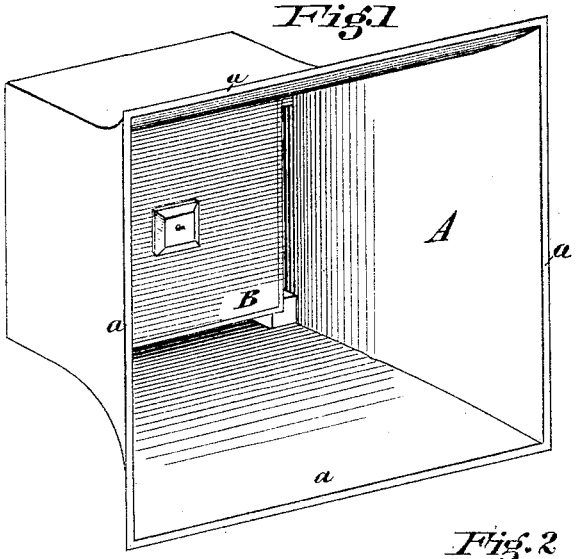


Fig. 2

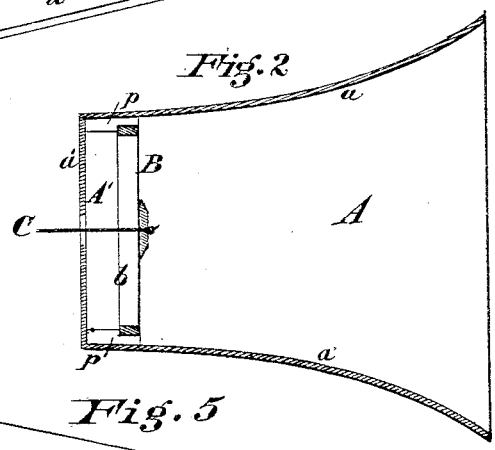
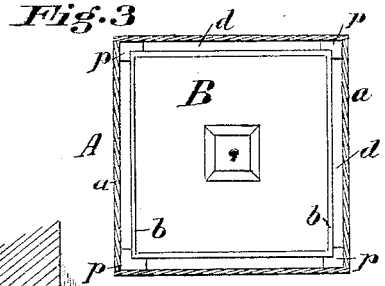


Fig. 3



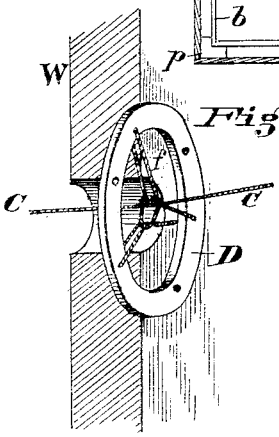
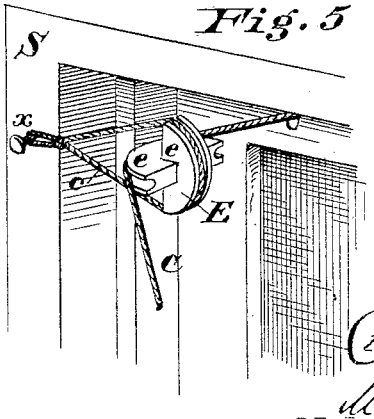


Fig. 4

Fig. 5



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UNITED STATES PATENT OFFICE.

CHARLES H. BILLINGS AND MARCELLUS J. MAXWELL, OF CINCINNATI, OHIO, ASSIGNORS OF ONE-THIRD THEIR RIGHT TO WALTER W. BOSTWICK, OF SAME PLACE.

IMPROVEMENT IN MECHANICAL TELEPHONES.

Specification forming part of Letters Patent No. **218,707**, dated August 19, 1879; application filed May 8, 1879.

To all whom it may concern:

Be it known that we, CHARLES H. BILLINGS and MARCELLUS J. MAXWELL, both of the city of Cincinnati, State of Ohio, have jointly invented certain new and useful Improvements in Acoustic Telephones, of which the following is a specification.

The object of our invention is to improve the apparatus constituting what is known as the "acoustic telephone," and to increase its power and efficiency as a means of transmitting sound or speech to distant points; and it consists—

First, in providing, in connection with the sound-chamber (which is both the sound receiving and transmitting device in such apparatus) and the diaphragm, an auxiliary chamber upon the remote side of the diaphragm, so connected with the principal sound-chamber as that the air-vibrations shall be effective on both sides of the diaphragm at the same time.

Second, in the combination, with the sound-chamber of a telephone, of a diaphragm arranged within such chamber in such manner that part of the sound-vibrations can pass around the diaphragm and be reflected from the rear wall of the sound-chamber against the rear sides of the diaphragm, as more fully hereinafter described.

It consists, also, in certain specific details of construction for carrying into effect the main principles of our invention, as above stated, and which will be hereinafter particularly described.

In the drawings herewith, Figure 1 is a perspective view of the bell-mouth receiving and transmitting sound-chamber. Fig. 2 is a side sectional elevation of the same. Fig. 3 is a plan view of the diaphragm, with the surrounding walls of the receiving-chamber in section, showing its relative arrangement therewith. Fig. 4 is a perspective view of the thimble or insulating device and its connections in position for operation. Fig. 5 is a perspective view of the elbow device with its connections in position for operation.

A is the sound-chamber, into which speech or other sound to be transmitted is projected, or through which it is received by the ear when transmitted.

As usually constructed, the chamber is a bell-mouth of circular section, and terminated at its smaller end by a diaphragm of sheepskin, or similar material, extending from and between its walls, connected at its center by a cord, C, with a similar diaphragm and sound-chamber at the terminus of the line. These parts constitute the essential features of what is commonly known as the "acoustic telephone," in which the vibrations of sound are transmitted by the ordinary conductivity of the connecting medium, in contradistinction to the electric telephone, in which the principle of conversion of sound vibrations or waves into electric waves is utilized. This apparatus has heretofore had but a limited usefulness, owing to the meager character of the results produced or deemed possible.

Our invention, however, increases the power and efficiency of the apparatus to a remarkable degree, and opens a wide field of utility hitherto unknown.

In the present instance we carry out the first part of our invention, which relates to the provision of an auxiliary sound-chamber in connection with the diaphragm, by so constructing the bell-mouth chamber and arranging the diaphragm in relation thereto that the diaphragm is constituted a partial partition, dividing the sound-chamber into two portions, but opening into each other by spaces around the diaphragm.

In carrying out this part of our invention by itself, the circular form of receiving-chamber may be employed, though, for reasons to be hereinafter explained, we prefer the square section shown in the drawings, whereby other new and important results are attained. In Figs. 1, 2, and 3 the construction is fully shown.

The sound-chamber A, inclosed by four side walls, *a*, arranged in square section, has a flaring opening and an end wall, *a'*, uniting the rear ends of the walls *a*. A short distance from the end wall, *a'*, and within the chamber A, the diaphragm B, mounted in a square frame, *b*, and supported on four corner posts,

P, is placed. The precise distance of the diaphragm from the wall *a* cannot be stated; but it should be so arranged as that each reflected vibration from the end wall, *a'*, should impinge upon the rear side of the diaphragm when reacting from the effect of the direct impulse upon its front side, in order to attain the best results.

The diaphragm B is made smaller than the sectional opening between the side walls, *a*, of the chambers, thus leaving an open space, *d*, around the diaphragm B, and giving a free passage for the air-waves from the principal chamber A into the auxiliary chamber *a*.

Any other mode of construction or arrangement of parts which affords an auxiliary chamber in connection with the receiving-chamber and diaphragm will embody our invention; but that shown and described we have found to produce the best results in actual practice.

In carrying out the second part of our invention, relating to such construction of the sound-chamber as to give it the function of the sound-board of musical instruments, it is necessary that the circular form be modified so as to enable the wall *a* of the chamber to be constructed of comparatively thin slabs of resonant wood, such as is employed for instruments like violins, &c.

In order to derive the best results it is desirable to use the wood in its natural state, and, therefore, a section having straight sides, as a triangle, square, or polygon is preferable, as the bending of the wood into circular forms impairs its vibrating qualities. Metals may be used also for this purpose, but the ring is objectionable.

After numerous experiments we have adopted the square section for the sound-chamber, and prefer Spanish cedar as the material for construction. In this form of the chamber an important and altogether novel augmenting effect is given to the air-vibrations by the coincidence of reflected vibrations from opposite sides and the non-interference of vibrations thus produced at right angles to each other. This effect will be obvious in view of the known laws of acoustics, and from a consideration of the before-described arrangement of the diaphragm with reference to the sound-chamber.

In this connection the third part of our invention, relating to the construction of the diaphragm and connections, will be readily understood. The diaphragm we construct of a thin slab of wood, of the same material and quality of material as the walls *a* of the receiving and transmitting chamber. This is done in accordance with the well-known fact that each kind of wood or other material of which the sound-boards of musical instruments are made has a special and individual capacity for receiving and transmitting sound-vibrations.

By using a diaphragm of the same resonant material composing the walls *a*, a complete harmony of vibratory action is established between them which can be attained in no other way. Thus the receiving-chamber A becomes not only a perfect receiving-instrument for imparting full and perfect vibrations to the transmitting mediums, but in delivering those vibrations at the terminus of the line has the function of a microphone, by which the transmitted vibrations (which are, of course, much weakened by the resistance of the transmitting medium) are restored to their original strength and delivered in the most satisfactory manner.

By the use of our invention a person seated in the middle of a room, in line with the opening of the sound-chamber A, (which may be secured to the wall,) may converse in ordinary voice with entire facility with another person similarly situated in a room several hundred feet away, neither person being required to approach the instrument either in sending or receiving a message.

The remaining parts of our invention relate to devices for conveying the sound from the sending to the receiving instrument. These are shown in Figs. 4 and 5. Fig. 4 shows an insulating-thimble, D, by which the transmitting-cord C is passed through a wall, W, or other obstruction. The wall is pierced with a hole of sufficient size to allow the cord to pass through without touching, and provided with a thimble, D, or flat ring of wood, which may be secured in the aperture or to the face of the wall around it. A small ring of the same material as the transmitting-cord C is secured in the central opening of the thimble D by radial cords, also of the same material, from the annular ring, and drawn taut. The transmitting-cord C passes through this central ring and may rest against it, and thus turn any angle, the peculiar structure of the sustaining device permitting longitudinal vibrations of the transmitting-cord with freedom.

Fig. 5 shows the elbow device E, for turning the transmitting-cord at an angle in its course. It consists of two half-pulleys, secured at right angles upon their several edges. A short cord, C, is passed over one of the half-pulleys, and is secured by its ends to a pin, *x*, upon the window-casing S or any convenient surface. The transmitting-cord C is then passed around the other half-pulley and turned to any desired angle and extended to its destination.

It is apparent that the first-mentioned half-pulley, *e*, serves nearly the purpose of a pivot, by which the other half-pulley is retained in connection with the wall, and about which the other pulley shall have the utmost freedom of rotation to accommodate the longitudinal vibrations of the transmitting-cord C. A single pulley with a pivot-connection may therefore be substituted.

The remaining part of our invention relates to the transmitting-cord C. We have found that by coating the cord, which may be of hemp or other fibrous material, with a varnish of shellac or similar material, its conductivity is greatly increased, besides being better pre-

served. It is also found that by using cords similarly coated for the thimble D, and for retaining the elbow device E to the wall, a complete insulation is obtained and the sound transmitted without impediment.

Having described our invention, what we claim, and desire to secure by Letters Patent, is—

1. A sound receiving and transmitting apparatus for telephone-lines in which a principal and auxiliary sound-chamber are combined in such relation to the diaphragm as that the air-vibrations are made effective on both sides of the diaphragm, substantially as and for the purpose set forth.

2. The combination, with the sound-chamber of a telephone, of a diaphragm arranged wholly within such chamber in such manner that part of the sound-vibrations can pass around the diaphragm and be reflected from the rear wall of the sound-chamber against the rear sides of the diaphragm, substantially as and for the purpose specified.

3. In combination with the sound-chamber A, the diaphragm B, mounted in the frame *b* and supported on corner posts, P, substantially as specified.

4. The insulating-thimble D, consisting of annular part D and cords *x*, substantially as and for the purpose specified.

5. The elbow device E, consisting of the half-pulleys *e*, joined at right angles, substantially as and for the purpose specified.

In testimony whereof we have hereunto set our hands this 2d day of May, 1879.

CHAS. H. BILLINGS.
MARCELLUS J. MAXWELL.

Witnesses:
WALTER W. BOSTWICK,
L. M. HOSEA.