(No Model.) 2 Sheets—Sheet 1.

A. C. F. MÜLLER.

MICROPHONE.

No. 452,758. Patented May 19, 1891.

FIG. I.

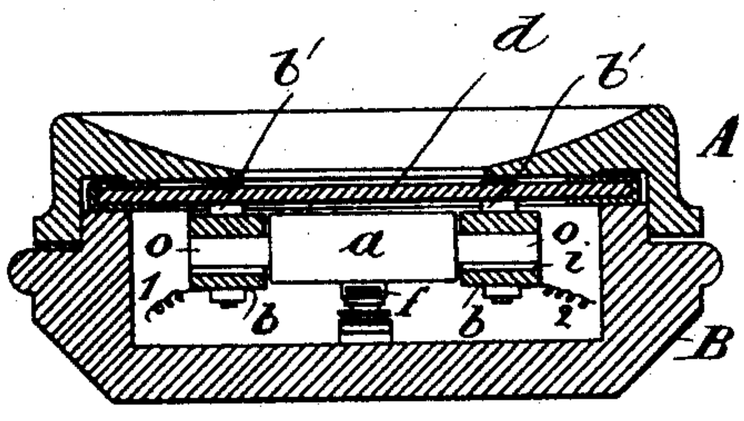


FIG. II.

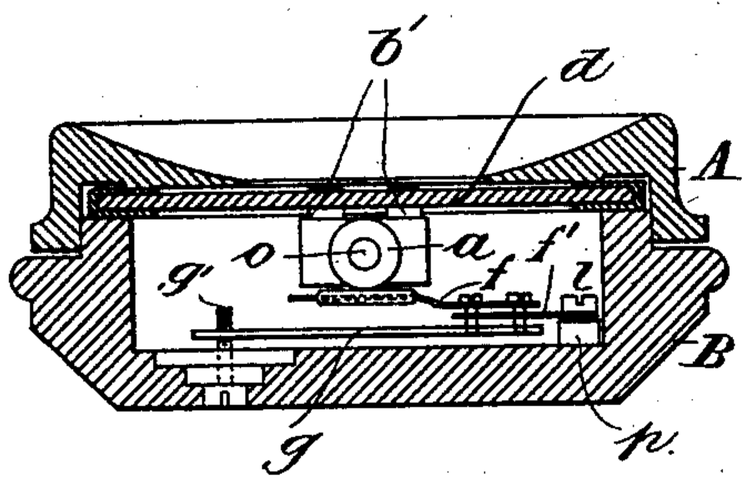


FIG. III.

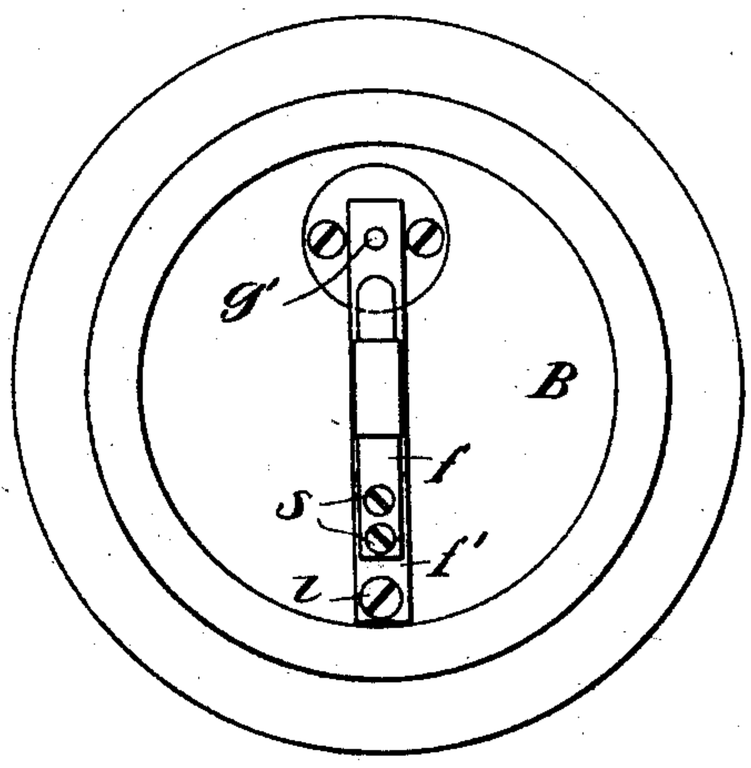
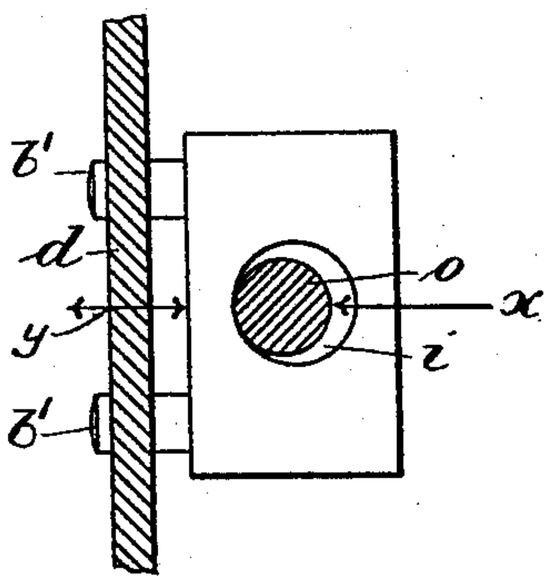


FIG. IV.



Witnesses:
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A. D. P. Weaver.

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per Henry Orth
Atty.

(No Model.) 2 Sheets—Sheet 2.

A. C. F. MÜLLER.

MICROPHONE.

No. 452,758. Patented May 19, 1891.

FIG. V.

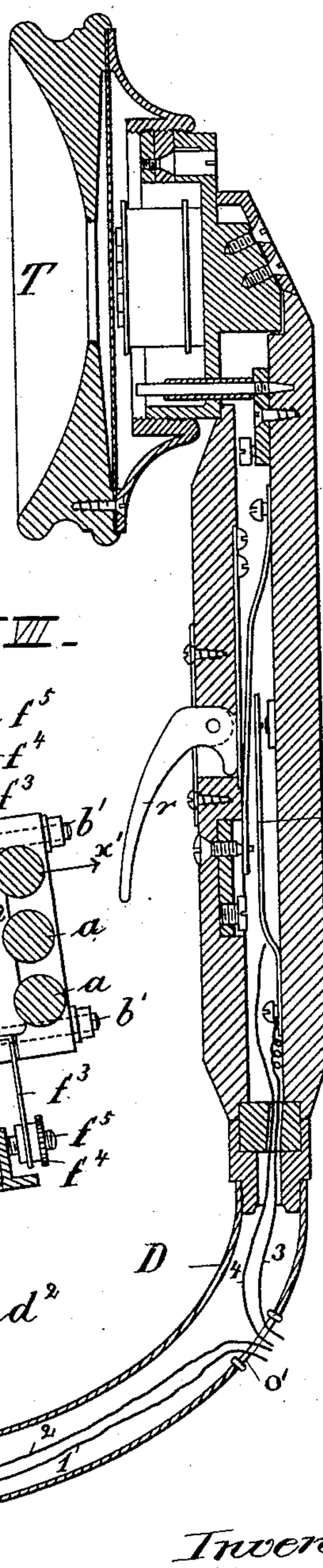

FIG. VI.

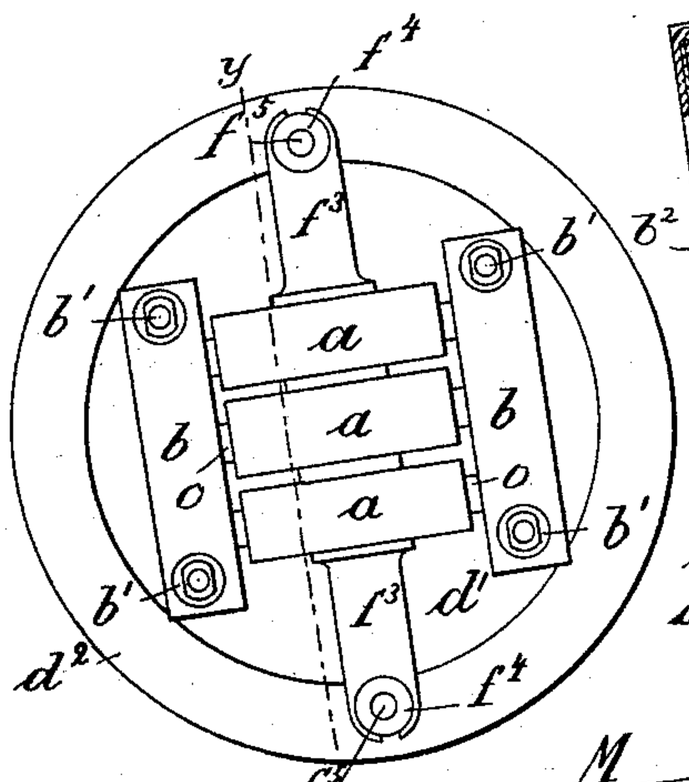

FIG. VII.

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UNITED STATES PATENT OFFICE.

AUGUST CARL FRANZ MÜLLER, OF BERLIN, GERMANY, ASSIGNOR TO MIX & GENEST, OF SAME PLACE.

MICROPHONE.

SPECIFICATION forming part of Letters Patent No. 452,758, dated May 19, 1891.

Application filed May 31, 1889. Serial No. 312,803. (No model.) Patented in France August 19, 1886, No. 165,292; in Belgium December 27, 1886, No. 75,724; in Sweden December 30, 1886, No. 1,120; in England October 5, 1887, No. 13,510; in Austria-Hungary January 15, 1888, No. 33,399 and No. 65,045; in Italy March 31, 1888, XXI, 22,859, and XLV, 163, and in Germany October 9, 1888, No. 46,929.

To all whom it may concern:

Be it known that I, AUGUST CARL FRANZ MÜLLER, foreman, a subject of the King of Prussia, residing at Berlin, 45 Louisen-Ufer, Prussia, German Empire, have invented certain new and useful Improvements in Microphones, (for which I have obtained patents in France, dated August 19, 1886, No. 165,292; in Belgium, dated December 27, 1886, No. 75,724; in Austria-Hungary, dated January 15, 1888, Nos. 33,399 and 65,045; in Italy, dated March 31, 1888, Vols. XXI and XLV, Nos. 22,859 and 163; in Sweden, dated December 30, 1886, No. 1,120; in Great Britain, dated October 5, 1887, No. 13,510;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Those microphones in which the contacts are formed by movable rolls or cylinders, as in the Ader system, can be employed only when the instrument is in a given position, for the reason that the contacts operate by gravity, and must therefore always lie in a given position to properly perform their function. These contacts are very sensitive, and are influenced by the slightest vibrations of the membrane or diaphragm, so that they are not only caused to operate by the stronger sound-waves—as, for instance, those produced in speaking to the instrument—but also by other feebler sound-waves, whether accidental or incidental, so that the transmission and reception of telephone messages become more or less confused, and at times unintelligible.

The object of this invention is to avoid this confusion and consequent difficulty of understanding telephone messages; to which end I provide means for controlling the function or operation of the contacts, so as to make them more or less independent of gravital function. By making such means adjustable the operation of said contacts may be so adjusted as that they will not be influenced by sound-waves other and feebler than those due to the act of speaking to the instrument, so that telephone messages free from conflicting sounds may be transmitted and clearly understood at the receiver. This leads to a further advantage, in that the instrument may be used in any desired position, and enables me to combine the same with an ordinary telephone-receiver, which is the further object of this invention. A microphone constructed according to my invention may therefore be placed in any desired position for use, and hence directly combined with a telephone, for example, to form a combined phonic receiver and transmitter.

Experiments have demonstrated that with my improved microphone and suitably-chosen induction rolls or cylinders spoken messages may be transmitted to a distance of one thousand kilometers and clearly understood.

To these ends the invention consists in the combination, with the contact-cylinders, of an adjustable yielding or flexible support acoustically isolated from the cylinders and adapted to hold the cylinders and diaphragm against vibrations due to sound-waves of a less power than that exerted by the support upon the contact-cylinder to hold the latter and the diaphragm against vibration, and in a special construction of diaphragm to protect the same against the influence of moisture.

In the drawings, Figures I and II are transverse sections, at right angles to each other, of my improved microphone. Fig. III is a top or inside view of the lower half of the casing of the microphone and parts connected therewith. Fig. IV is a detail sectional view of the diaphragm, the contact-cylinder, and one of its bearings. Fig. V shows the microphone connected directly with a telephone-receiver. Figs. VI and VII show, respectively, a rear face view and a section on line *y y* of Fig. VI of the operative elements of a microphone constructed according to my invention, in which a plurality of contact-cylinders are employed.

Referring more particularly to Figs. I to IV, inclusive, which show a microphone hav-

ing a single carbon contact-cylinder, A and B indicate the mouth-piece, between which the diaphragm *d* is secured.

a is the carbon contact-cylinder provided at its ends with attenuated extensions or journals *o*, that have their bearings in carbon-blocks *b*. The bearings or blocks *b* are secured to the diaphragm *d* by means of screws *b'*, as more clearly shown in Figs. IV to VII. The carbon contact-cylinder is pressed in the direction of arrow *x*, Fig. IV, or toward the diaphragm *d*, by means of a spring *f*, that is provided with a cushion or contact face of soft or elastic non-conducting material, such as rubber or velvet or felt or other like material, so that the journals *o* will bear against one side of their bearings, the openings *i* in which bearings are of slightly greater diameter than said journals, as shown in said Fig. IV.

The object of providing the spring *f* with a cushion or contact-face of non-conducting material, as described, is to acoustically isolate the carbon cylinder from the spring-fastenings, and consequently from the mouth or ear piece to prevent the sound-waves that strike the mouth-piece or casing from being transmitted by good sound-conductors to the carbon cylinder, so that the vibrations of the diaphragm alone, which diaphragm is also acoustically isolated from the casing by means of the rubber gasket, will be transmitted to said cylinder. Sound waves directed toward the diaphragm *d* will cause the same to vibrate in the direction of the double arrows *y*, Fig. IV, and since the cylinder *a*, under the influence of the spring *f f'*, is forced in the direction of the arrow *x*, Fig. IV, it follows that the variations or fluctuations in the pressure or force of contact between the journals *o* of the carbon cylinder and their bearings *b*, due to the variation or fluctuation in the vibratory movements of the diaphragm, can alone influence the electric current passing through said parts. A motion or vibration of the diaphragm in any other direction will therefore have no influence upon this contact pressure, whether the diaphragm is in a vertical, horizontal, or in any other desired position. The spring is preferably made of two parts *f* and *f'*, as shown in Figs. II and III, said parts being connected together by screws *s*, one end of the part *f'* of the spring being secured to a post *p* by means of a screw *l*.

To provide means for adjusting the tension of the spring *f f'*, and consequently the degree of pressure or force of contact between the carbon cylinder and its bearings, I employ the adjusting-spring *g*, through one end of which passes the adjusting-screw *g'*, while the free end of said adjusting-spring impinges upon the screws *s*, that unite the parts *f* and *f'* of the spring. As shown in Fig. II, the head of the adjusting-screw *g'* lies in a recess in the rear wall of the mouth-piece, so that the adjustment may be effected from the outside. By the means described the force of contact between the journals of the carbon cylinders *a* and their bearings may be regulated with great nicety and to the desired or required degree.

Instead of a single carbon cylinder, a plurality of such may be employed, as shown in Figs. V and VI, in which I have shown three carbon cylinders *a* held to one side of their bearings, as indicated by arrow *x'*, by means of a felt-covered elastic bridge f^2. The spring-arms f^3 of the bridge f^2 are forked at their outer ends, the fork straddling a nut f^4, adjustable on the screw-stems f^5, whereby the degree of pressure or contact between the cylinder-journals and their bearings may be regulated.

I have found by experience and practice that a thin diaphragm of pine wood is best suited for microphonic transmission, the tone of the voice undergoing the least change where such a diaphragm is used. Diaphragms made of a resonant wood are, however, extremely sensitive to and readily influenced by atmospheric changes, and especially by moisture, which causes them to warp, thereby changing the points of contact between the cylinder-journals and their bearings. Attempts have heretofore been made to guard against these influences upon wooden diaphragms by a protecting-coating of a water-repellent—as, for instance, by varnishing the diaphragm or coating the same with shellac. This has, however, proven insufficient, in that the coating is liable to crack in a short time, which is chiefly due to the rapid evaporation of the moisture on the diaphragm and resulting from the breath of the speaker, the moisture then penetrating to the membrane through these cracks and causing it to warp. I avoid this disadvantage, in that I apply to both sides of the membrane, a thin plate of a material that is not hygroscopic and that is impermeable to moisture, and I protect the edges of the diaphragm by means of a rubber ring or gasket d^2, such as is usually employed.

As described in Letters Patent granted with my knowledge and consent to Messrs. Mix and Genest, of Berlin, under date of October 9, 1888, No. 46,929, the material I have found to be most suitable is mica, the sheets or plates of which should be sufficiently thin, so as not to affect or influence the vibrations of the resonant diaphragm. Other materials may, however, be employed—as, for instance, celluloid, vulcanite, rubber, or paper saturated with oil, or other similar substance, or the diaphragm may be coated with collodion, yet neither of these is so well adapted to the purpose as mica.

As shown in Figs. V and VII, the diaphragm *d* is provided upon both faces with a thin mica plate *d'*, and the three plates are held together by a rubber ring or gasket d^2, U-shaped in cross-section, whereby the posi-

tioning of the diaphragm and its mica plates between the parts A B of the mouth-piece is effected.

I have found that the cementation of the mica plates to the diaphragm is not particularly advantageous, and to more securely connect the said mica plates to the diaphragm the screws *b'*, by means of which the bearings *b* are secured to said diaphragm, may be utilized, as shown in Figs. V to VII.

As already stated, the microphone, constructed as described, may be used in any desired position, since its contacts are independent of their operation by gravity, so that such a microphone may be directly combined with a telephone, as shown in Fig. V. The lower half B of the mouth-piece of the microphone M is, as shown, provided with a hollow curved stem or arm D, that is connected with the telephone-receiver T in such manner as that when the said receiver is applied to the ear the microphone will be in proper proximity to the mouth.

The electrical connections of the microphone are indicated by I and II and those of the telephone-receiver by III and IV, all of said connections passing out of the instrument through an opening *o'*.

The telephone-receiver T may be cut out of the circuit by means of the contact-spring *p'* and the cam-lever *r* in a well-known manner.

I claim—

1. In a microphone, the combination, with the diaphragm, a rolling electrode, and suitable contacts, of a spring operating to hold the electrode to its contacts, and a sound-deadening material, such as described, interposed between the spring and the electrode, for the purpose set forth.

2. In a microphone, the combination, with the diaphragm, a rolling electrode, and suitable contacts, of a spring adjustable as to tension operating to hold the electrode to its contacts, and a non-conducting and sound-deadening material, such as described, interposed between said spring and electrode, for the purpose set forth.

3. In a microphone, a diaphragm of wood in combination with a covering of mica, for the purpose set forth.

4. In a microphone, the combination, with the diaphragm having carbon journal-bearings connected therewith and a carbon contact provided with journals adapted to vibrate in the said bearings, of an auxiliary resilient bearing for and acoustically isolated from the carbon contact and operating to maintain the journals thereof in contact with their bearings by an elastic pressure, substantially as and for the purposes specified.

5. In a microphone, the combination, with the mouth-piece and a diaphragm of wood secured therein, of an envelope of mica and rubber for said diaphragm, substantially as and for the purposes specified.

6. In a microphone, the combination, with the mouth-piece and a diaphragm of wood secured therein, of a protective envelope composed of mica covering both faces of the diaphragm, and a gasket of rubber encompassing the edges of the diaphragm and its covering, substantially as and for the purposes specified.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUST CARL FRANZ MÜLLER.

Witnesses:
B. ROI,
ADOLF DEMELIUS.