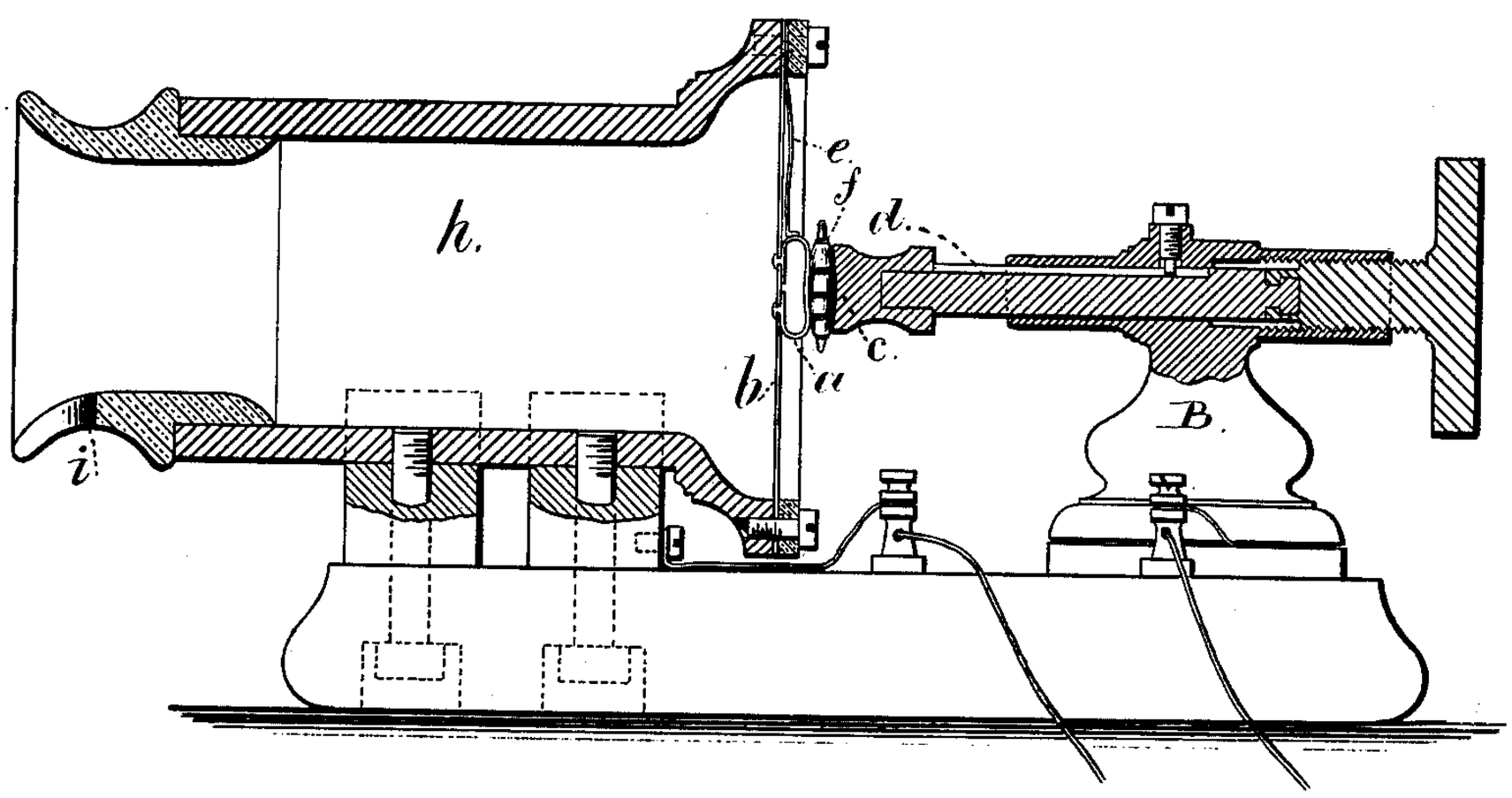
T. A. EDISON.

Speaking-Telegraph.

No. 203,015. Patented April 30, 1878.

Fig. 1.



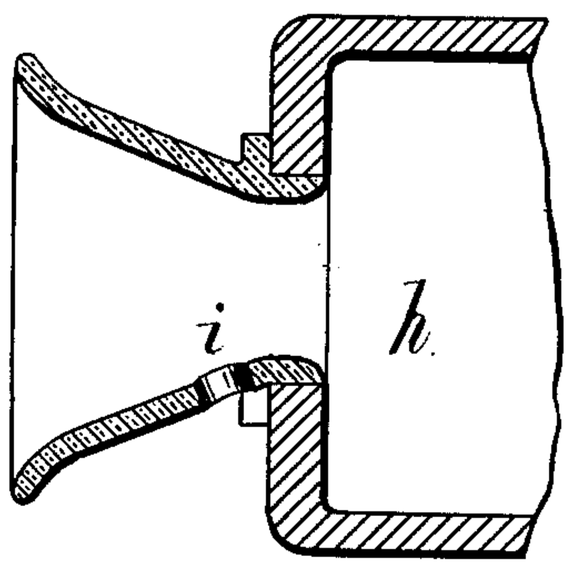


Fig. 2.

Witnesses

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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y.

IMPROVEMENT IN SPEAKING-TELEGRAPHS.

Specification forming part of Letters Patent No. **203,015**, dated April 30, 1878; application filed August 28, 1877.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented an Improvement in Speaking-Telegraphs, of which the following is a specification.

The object of this invention is to transmit and reproduce the human voice over telegraphic circuits.

The invention, which is a modification of an application for patent filed by me April 27, 1877, consists in the following particulars: A mouth-piece provided with a slot or hole to allow of the escape of the air ejected from the mouth in the act of making a hissing consonant, thus preventing a bulging of the diaphragm, and at the same time increasing in a surprising manner the movement of the diaphragm when such hissing sounds are made.

The invention further consists in the employment of mica as a diaphragm. I have discovered that of many substances which are suitable for diaphragms, it alone will give the greatest amplitude of vibration with the least harmonical or extra sound; that it remains unaffected by the heat and moisture of the mouth, and does not get out of adjustment by stretching, like thin substances that have heretofore been used for diaphragms.

The invention further consists in a yielding contact plate-spring secured to the diaphragm so as to allow the diaphragm to make its full vibration while such spring is pressing against the tension-regulator next referred to.

The invention further consists in a tension-regulator made of elastic fiber and electric conducting material, whereby the resistance of the circuit is decreased by the compression of the fiber, bringing the conducting material into more intimate contact, or the resistance is increased by the expansion of the fiber.

In my application No. 141, filed July 20, 1877, a piece of plumbago is described for varying the resistance by pressure, and I have shown a piece of plumbago arranged in front of a diaphragm operated by the human voice, and connected with the telegraphic line in such a manner that when the diaphragm went outward it would cause pressure upon the plumbago, and this would increase the electric wave in the circuit, and if the diaphragm was vibrated weakly a light pressure would be placed on the plumbago, and a weaker wave would be sent, thus producing waves of a strength proportional to the tones of the voice. This does not give as perfect articulation as the tension-regulator I am about to describe, principally on account of the great difference in pressure, or greater amount of pressure required to effect a given change. I have discovered that if any fibrous material—such as silk, asbestus, cotton, wool, sponge, or feathers—be coated, by rubbing or otherwise, with with a semi-conducting substance, such as plumbago, carbon in its conducting form, metallic oxides, and other conducting material, and such fiber be gathered into a tuft and placed in a circuit, it is very sensitive to the slightest movement. I am enabled not only to obtain the regulation by the greater or less pressure, but also to increase or decrease the extent of surface-contact between the particles of conducting or semi-conducting material that is associated with the fiber.

It is best to use fibers that are springy, such as sponge or silk, so as to prevent the materials packing and the regulator losing its elasticity.

I prefer to use unspun silk fiber, cut in lengths of about one-sixteenth of an inch, which are then coated with plumbago by thorough rubbing, or by using a mucilaginous paste of plumbago, rubbing and thoroughly drying, after which the fiber, with a little loose plumbago, is rolled into a cigar shape, and retained by a binding-fiber of silk. I propose to call these "articulators" or "electric tension-regulators."

Another method of metallizing the fiber which I propose to employ is to soak the fiber in a solution of nitrate of silver or other metallic salt, and reduce the metal to a metallic state upon the fiber by a suitable reducing agent, such as exposing the silk to the fumes of phosphorus, this process of metallization being well known among electroplaters for causing non-conducting articles to become conductors for receiving a deposit of metal thereon.

The fiber may be moistened with a semi-conducting fluid, and operate in precisely the

same manner, the resistance being lessened by compressing the fiber, and vice versa.

The electric tension-regulator *f*, I place between a conducting-spring, *a*, secured to the diaphragm *b*, and the conducting point or plate *c*, secured to the adjusting-post *d*, and adjust it so that when the diaphragm is in a state of rest the regulator will remain in contact with both *a* and *c* by pressure. This tension-regulator may be employed in various electric instruments—such as rheostats—to regulate the electric current passing at a given place according to the pressure exerted upon the mass of fiber.

In the drawing, Figure 1 is a section of a transmitting-instrument with my improvements applied thereto. Fig. 2 is a modification of the mouth-piece.

The line-circuit passes to the spring in the center of the diaphragm by the platina foil *e;* thence through the articulator or tension-regulator *f* and contact *c* to the pillar B; thence to battery and earth or return wire.

At the distant station the line enters any suitable receiving-instrument, which may be an electro-magnet secured to a resonant box or operating-diaphragm operated by the armature or other device.

The plate *a* is attached firmly to the mica diaphragm or tympan *b* by making small holes in the mica and soldering the plate to the mica, the solder entering the holes and adhering by the roughness of the surfaces of such holes.

When the diaphragm on the transmitter is in a state of rest, the circuit is closed, and a constant but weak current passes through the circuit, the tension-regulator offering, say, two thousand ohms resistance.

If the slightest sound is made near the mouth-piece, the diaphragm is set vibrating, and the fibrous regulator is compressed and expands at each vibration, thereby increasing and decreasing its resistance many ohms, and causing a rise and fall of tension within the circuit, and these waves so produced act upon the distant receiving-instrument, when these vibrations are reproduced.

In speaking into the case *h*, or into the resonant-box of any telephone, there is difficulty in transmitting the sounds from consonants, because the hissing sound produces a pressure upon the diaphragm instead of a vibration. I obviate this difficulty by an opening in the speaking-tube with an edge or angle, against which the hissing sound is directed, and which responds to such sound, and communicates the same to the diaphragm; and as this hissing sound, in pronouncing some of the consonants, passes downwardly from the mouth, I introduce a notch or orifice, at *i*, in the lower part of the speaking-tube *h*, so that, the sound passing down through the slot and striking the sharp edges of the slot, the hissing sounds are intercepted and cut and turned into vibrations, and these, acting upon the diaphragm, increase enormously the distinctness and volume of the hissing sounds at the receiving-instrument.

In speaking-tubes where there is no slot the air ejected in pronouncing hissing consonants, having no escape, causes the diaphragm to bulge outward, and so lessen the resistance of the circuit, and not transmit the hissing sounds except when exceedingly loud. A large hole in the tube near the diaphragm prevents the bulging of the diaphragm; but it does not increase the effect of the hissing sounds, but on the contrary weakens them, as well as the vowel-sound.

It is obvious that many modifications of the mouth-piece may be made so long as the holes or slots are located so that their edges cut the hissing sounds for the purpose set forth. A tube with a hole or slot, *i*, having a sharp edge between the mouth-piece and diaphragm, as in Fig. 2, may be used.

I have found that mica, owing to its being composed of innumerable layers of thin sheets, does not give a ringing sound or harmonics like most other substances which have equal strength, rigidness, &c., especially metals, and it is not affected, except in an unimportant extent, by the heat and moisture from the mouth; neither does it stretch like metal. All these properties are essential in a speaking-telegraph for insuring permanency and absence of false vibrations or harmonic responses, and for obtaining perfect articulation.

Animal membranes are inconstant, and are too sensitive to heat and moisture, and are constantly stretching. I use a spring in the center of the diaphragm, which is somewhat weaker than the diaphragm, and this is for the purpose of allowing the diaphragm to have a more free movement, the spring serving to take up by its elasticity the effect of the sudden check of the diaphragm when the fiber has been compressed too greatly by loud speaking.

The adjusting-post *d*, by preference, is made so that the disk is brought toward the diaphragm without being turned, so as to prevent disturbing the fibrous tension-regulator.

It is obvious that many devices (other than the mere pressure of the diaphragm against the conducting-fiber) may be used to secure the fiber.

I claim as my invention—

1. In an instrument for transmitting electric impulses by sound, a diaphragm or tympan of mica, substantially as set forth.

2. In an instrument for transmitting electric impulses by sound, the combination, with a diaphragm or tympan, of an electric tension-regulator of fiber and electric conducting material, substantially as set forth.

3. An electric tension-regulator composed of elastic fibrous and electric conducting material.

4. The combination, in an electric instrument actuated by sound, of a diaphragn or tympan, a conductor, and an electric tension-regulator composed of elastic fiber and electric conducting material.

5. The combination, with an electric ten-

sion-regulator composed of fiber and electric conducting material, of a variable presser acting upon such fiber, substantially as set forth.

6. The combination, with a diaphragm or tympan of mica, of an electric conductor and pins of solder passing into holes in the mica to secure said conductor, substantially as set forth.

7. In an instrument for transmitting electric impulses by sound, a resonant case having an opening near the mouth-piece, substantially as and for the purposes set forth.

8. In an instrument for transmitting and reproducing the human voice or other sound, a closed telegraphic circuit containing a battery and compressible elastic material operated by the sound, for increasing and decreasing the resistance to the battery-current, substantially as set forth.

Signed by me this 16th day of August, A. D. 1877.

THOS. A. EDISON.

Witnesses:
WILLIAM G. MOTT,
CHAS. H. SMITH.