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BARNEY'S IMPROVEMENTS IN TELEPHONES.

Amongst recent patented improvements in telephonic instruments we find as specially deserving of notice, those devised by Mr. W. C. Barney, of 53, Bernard street, London, whose specification (No. 4905, 1881,) describes several forms, the most useful of which have perhaps to be discovered; but excellent results have, we understand, been obtained with one form already tried. The invention comprises both transmitting and receiving instruments. In microphones heretofore constructed the quantity of electricity passing through them is extremely small, and represents an almost infinitesimal part of the electric power emanating from the source of electricity employed. The current which passes through a microphone used for telephonic purposes should be as great as possible, having due regard to the sensitiveness of the microphone to the action of sound-waves upon it, because the variations of the intensity of the current produced by the action of the sound-waves are in proportion to the variations of the resistance of the microphone. Various forms of microphone have been devised, some in which the variations of the contact-points of the several parts of the microphone are caused by means of a spring or springs, others by means of a tympan. The microphone invented by Professor Hughes is simple and effective. In a microphone constructed on the principle of Professor Hughes, the greater the number of points of contact the greater will be its conductibility, which is a great desideratum. The microphones devised by Mr. Barney offer the least possible resistance to the passage of an electric current, and, at the same time, possess the greatest sensitiveness to the action of sound-waves; consequently, the current induced in the secondary wire of the induction-coil, to the primary wire of which the microphone and battery are connected, has great variations of tension, and its action on the coil of the receiving instrument is proportionately great. In one form of the microphone, which we select for illustration, Fig. 1, a number of pencils, P, of hard coke-carbon, or other equivalent material, are used, the ends of the pencils being held loosely in blocks C of carbon. A block of carbon B, to which is connected one terminal of the primary wire of an induction coil, about one inch in diameter, and about half an inch thick, forms the centre of the series of blocks of carbon placed around at a distance of about two inches from it; this periphery of blocks is connected together by any good conductor, to which is connected one pole of a battery, the other pole thereof being connected to the other terminal of the primary wire of an induction coil. The centre block has a series of holes around its circumferenee, equal in number to the blocks surrounding it, and in each of these blocks is a hole, in which lies loosely one end of a carbon pencil P, the other end of which lies loosely in a hole in the centre block. Each pencil is covered with a metallic sleeve, which must not be in contact with any of the blocks; this metallic sleeve increases greatly the conductivity of the pencil, and also increases its specific gravity, both of these effects being advantageous. Another form is made with carbon pencils and carbon bars in the following manner:—Two carbon bars about half an inch thick, having a length proportionate to the number of pencils used, are placed parallel to each other about two inches apart. They have a series of holes in the sides facing each other, in which holes lie loosely the ends of carbon pencils, thus connecting electrically the two bars of carbon, one of which is to be connected to one terminal of the primary wire of an induction-coil, and the other bar to one pole of the battery, the other pole thereof being connected to the other terminal of the primary wire. A third carbon bar may be added with carbon pencils connecting it electrically with one of the other bars; in this arrangement the two outer bars should be connected together by a good metallic conductor, to which one terminal of the primary wire should be connected, and the centre bar should be connected to one pole of the battery. In another form the patentee dispenses with carbon, and uses pencils of wood, bone, ebonite, or any equivalent suitable material, placing on each end of the pencil a small capsule of hard tin, or of any hard metal, preferably platinum; the capsules on each pencil are connected together by a metallic conductor, such as fine copper wire or tinfoil; the capsule ends rest loosely in similar capsules placed in holes in blocks or bars of wood, ebonite, bone, cork, or any suitable non-conducting material. The exterior surfaces of the capsules on the pencils are roughened, and the interior surfaces of the capsules in the holes of the blocks are also roughened. The connections of this microphone with the induction-coil and battery are made in the same way as above described for carbon microphones. In order to confine the movements of a microphone to the direct action exclusively of sound-waves, and to avoid any secondary movements of it which must occur when sound-waves act upon a microphone through the medium of a tympan or of any vibratory plate, which movements interfere materially with its faithful response to the sound-waves, the blocks or bars are firmly secured to a flat surface of a non-resonant, non-vibratory, sound absorbing material, such as cork. This material may or may not form one side of a box made of the same material. If inclosed thus in a box, or not inclosed, the material on which the carbons are fixed must not be fastened to any other material, but should rest loosely in a narrow frame of wood or other suitable material, or it may be suspended in any convenient manner; when pumice-stone is used the bars or blocks may be clamped between two pieces of pumice-stone. The sound-waves may fall directly upon the carbons or other pencils, or upon the obverse side of the material to which they are fixed. The object of leaving the material to be kept in its place by its own *vis inertiæ* only is to allow the whole mass to be moved by the impact of sound-waves upon it. The molecular movement in these light, porous substances being much greater than in dense compact substances, will communicate to the fixed blocks or bars a much greater movement than denser material would. Microphones thus attached to porous substances will be affected by the molecular movement in these substances, as well as by the movement of the mass, and there cannot be any compression of the carbon; but the effect of sound-waves upon it is to vary the surface contacts by a shaking or joining, or molecular motion; it may be possible that there occur rapid makes and breaks of the circuit; but these, however, are so rapid that an undulatory current flows, corresponding faithfully to the sound-waves, which is not the case when sound-waves act on the microphone through the medium of a tympan or vibratory plate, because the vibrations of a tympan or plate produce secondary motions.

In order to protect a microphone from the secondary action of any vibrations which might occur when the fixed parts of a microphone are attached to the surface of any material whatever, the patentee attaches the series of blocks surrounding the centre block, Fig. 1, to a narrow flat ring of copper, or other suitable metal, and the centre block is attached to a narrow strip of wood, ebonite, or any non-conducting equivalent material, lying across the centre of the ring, to which its two ends are secured.

The efficiency of microphones constructed with pencils and blocks or bars depends in a great measure upon the angle of inclination which the pencils make with the perpendicular. When the pencils stand perpendicularly their *vis inertiæ* is almost entirely at their lower ends, and when they lie horizontally their *vis inertiæ* is equally divided between the two ends. In this latter position the force of the sound-waves necessary to overcome their *vis inertiæ* is the maximum force, and in the former position the force required to overcome the *vis inertiæ* of their upper ends is the minimum force; but the contacts there being very slight, the current passing through these ends will be very feeble, and consequently the variations of the current passing through the microphone would be very slight, inasmuch as the current passing through the lower ends of the pencils would be almost uniform. The greater the variations of the quantity of current passing through a microphone used in a telephonic circuit, the greater will be the effect on the coil of the receiving instrument; hence it is necessary that a microphone should combine great sensitiveness to sound-waves with the bearings of the contacts of its several parts so arranged as to present the greatest surfaces of contacts where the variations of the current are produced.

A microphone composed of from eight to ten pencils connected together for quantity, inclining at an angle of about 20° from the perpendicular, gives excellent results. The microphone can be placed in a box of wood, ebonite, brass, iron, or any suitable material, about one inch from one of its sides, in which there is the usual hole with a mouthpiece, care being taken to have a hole in each side of the box between the microphone and the side of the box to which the mouthpiece is attached.

In the case of telephones, the patentee asserts that a plate, or diaphragm, or tympan must be held in close contact with the pole or poles of a magnet, and the plate, diaphragm, or tympan need not necessarily be made of iron or steel, or of any