S. G. BROWN.

TELEPHONE TRANSMITTER.

APPLICATION FILED JAN. 3, 1912

1,096,677.

Patented May 12, 1914.

Fig. 1.

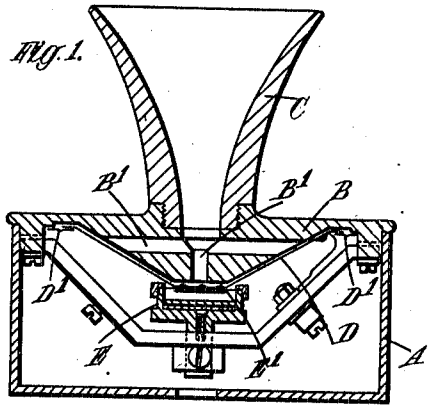


Fig. 2.

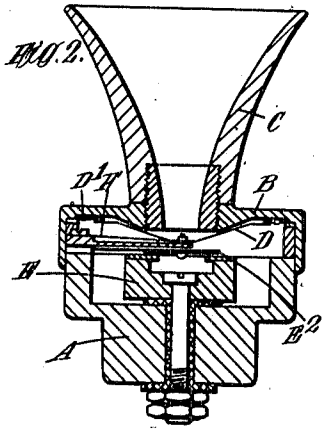


Fig. 3.

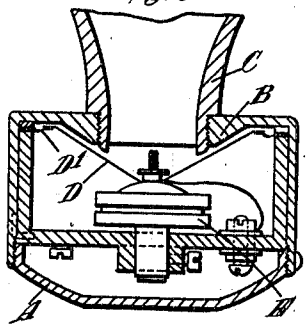


Fig. 4.

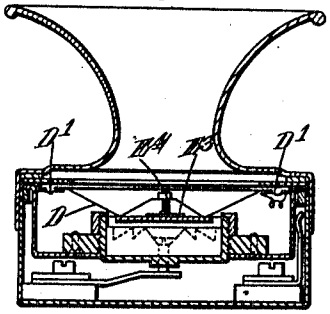


Fig. 9.

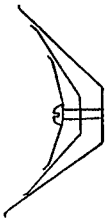


Fig. 7.

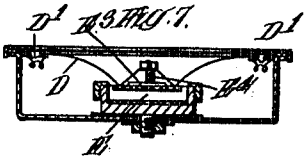


Fig. 5.

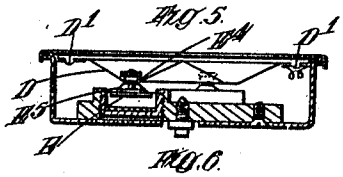


Fig. 6.

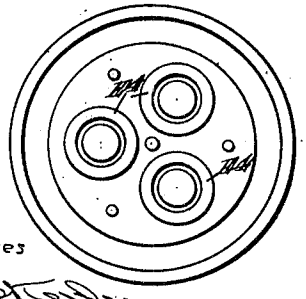
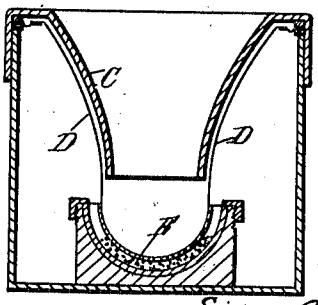


Fig. 8.



Witnesses

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UNITED STATES PATENT OFFICE.

SIDNEY GEORGE BROWN, OF LONDON, ENGLAND.

TELEPHONE-TRANSMITTER.

1,096,677. Specification of Letters Patent. Patented May 12, 1914.

Application filed January 3, 1912. Serial No. 669,150.

To all whom it may concern:

Be it known that I, SIDNEY GEORGE BROWN, a subject of the King of Great Britain, residing at 4 Great Winchester street, in the city and county of London, England, have invented certain new and useful Improvements Relating to Telephone-Transmitters, of which the following is a specification.

This invention relates to telephone transmitters.

The diaphragm of the ordinary telephone transmitter is peripherally gripped, with the result that since it cannot vibrate uniformly at all points on its surface its responsiveness to the acoustic vibrations falling upon it is far from being efficient; moreover it is usually comparatively heavy with the result that its inertia makes it sluggish in action. With a view to rendering the diaphragm more free to vibrate uniformly, it has been proposed to provide for flexibility at its peripheral support, but the essential conditions necessary for high efficiency have not, so far as I am aware, been fully realized. Owing to the great difference between the density of air and of solid materials such as are used for diaphragms there is a tendency for a large part of the energy of the air vibrations produced by speaking into the transmitter to be reflected from the surface of the diaphragm upon which the air beats. Hence, one of the main essential conditions for a diaphragm is extreme lightness; a comparatively large surface being essential, extreme lightness involves extreme thinness. An extremely thin diaphragm yields to the impacts of the vibrating air, a large percentage of the energy of the air being thus absorbed by the substance of the diaphragm. It is however useless to transfer the energy of the vibrating air to the diaphragm unless the latter is able to transmit it to some point where it can be usefully employed. If, for instance, the diaphragm were able to vibrate without control, its kinetic energy could not be utilized, and it therefore follows that a further main essential property of the diaphragm must be symmetrical rigidity. A simple and efficient way of making the diaphragm rigid is to impart to it a conical shape. Extreme lightness and symmetrical rigidity are however insufficient to insure the highest efficiency unless the energy absorbed by the diaphragm and transmitted through its substance is all concentrated at the point where it can be usefully employed; for this reason, peripheral support, even if resilient, is inefficient because it presents a path by which the energy can leak away from the diaphragm to points where no use can be made of it. A further essential condition, therefore, is that the diaphragm must be supported only at its point of symmetry, that is, its center, its periphery being left entirely free, or connected to the inclosing casing merely by a flexible ring of material offering no mechanical restraint upon the diaphragm.

According to the present invention the diaphragm of the telephone transmitter is so formed and mounted that the main essential conditions for efficiency above stated are realized. The diaphragm is made of light material, as for example aluminium, and is unusually thin, the thickness being of the order of 2½ thousandths of an inch. Some idea as to the lightness of the diaphragm may be gained from the fact that if it is allowed to drop to the ground it does not fall like a heavy mass of metal, but moves gently or flutters through the air. The diaphragm is shaped to impart rigidity to it, being preferably conical. It is supported by its center, its periphery being left entirely free, or connected to a mere flexible ring of material that offers practically no restraint and no pathway for the escape of energy. The diaphragm is preferably thickest at its center and of gradually decreasing thickness toward its periphery, so that the energy absorbed by the diaphragm from the adjacent vibrating air is conveyed to the center of the diaphragm with maximum efficiency. Owing to the extreme lightness of the diaphragm, its inertia is small, and its sensitiveness to impressed vibrations is therefore great. In the case of making the diaphragm from a workable metal such as aluminium or aluminium alloy, it may conveniently be spun from a disk into a conical shape with a flat center piece; by starting the spinning operation at the edge and working toward the center the desirable result of minimum thickness at the edge and graduated thickness toward the center is obtained. To increase this effect several such disks of different diameters may be assembled into a pile, and these disks may if desired differ in their conical angles for increased stiffness. The stiffness or rigidity

of the diaphragm may also be increased, if desired, by forming radial ribs or corrugations on it. The diaphragm is attached by its center to the mica disk or other inclosing member of the usual granular carbon cell or "button", forming part of the transmitter.

A further point of importance in obtaining efficiency in a telephone transmitter is the nature of the air space that is adjacent to the surface of the diaphragm and contains the air by means of which the vibrations imparted to the air by speaking are conveyed through the aperture at the base of the usual mouth piece and up to the actual surface of the diaphragm. In this connection particular care should be taken in the formation of the space between the narrow end of the mouth piece and the actual surface of the diaphragm; this space should be such as to maintain the pressure conditions existing at the narrow end of the mouthpiece and thus prevent any appreciable loss in energy transmission by a sudden drop in pressure or otherwise. In order to reduce the excessive amount of space presented by a conical diaphragm, the cover piece to which the narrow end of the mouth piece is attached is conveniently coned inwardly on its inner face so as to conform approximately to the shape of the diaphragm. According to a further feature of the present invention, therefore, the amount of air space adjacent to the surface of the diaphragm is in some cases purposely reduced, below what it would be in the case of a conical or dished diaphragm and a flat cover piece, by shaping the inner surface of the latter to correspond to some extent to the contour of the diaphragm; for instance, in the case of a conical diaphragm, the inner surface of the cover piece may be formed conically also.

It has been found in actual practice that the proportion of energy transferred from the air to the diaphragm in a telephone transmitter constructed as above described is from four to six times as great as the proportion transferred in the ordinary transmitter in common use at the present time.

In the accompanying drawings:—Figure 1 is a sectional elevation of one form of granular carbon cell transmitter constructed in accordance with my invention. Fig. 2 shows a modified construction in which a blade spring is provided to control the diaphragm. Fig. 3 is a sectional elevation of a "button" type of transmitter, and Fig. 4 a "solid-back" type of transmitter constructed in accordance with the invention. Fig. 5 is a sectional elevation and Fig. 6 a plan of a transmitter in which the diaphragm is supported at three points instead of at its center. Fig. 7 is a sectional elevation of a granular form of the transmitter in which the diaphragm is trumpet-shaped instead of being truly conical and Fig. 8 shows a further modification of this kind. Fig. 9 is a view showing a still further modification of the diaphragm.

A is the casing of the transmitter, B the cap or cover piece, C the ebonite mouth piece, D the diaphragm, and E the variable resistance device within the casing A.

In the construction shown in Figs. 1 and 2 the variable resistance device E is the ordinary granular carbon cell, and the flat center piece of the conical diaphragm D is secured to the mica disk E′ of the device E. To the opposite face of the mica disk a sheet of carbon is secured, and this sheet may if desired be ribbed or corrugated or otherwise stiffened so as to increase the strength and rigidity of the center portion of the diaphragm as well as to effect a good electrical contact with the contents of the cell. The air space in front of the diaphragm is preferably separated completely from the air space behind the diaphragm by a thin ring D′ of pliable material fastened to the periphery of the diaphragm and to the body of the transmitter, or preferably to a removable ring clamped between the cover piece and the casing. This ring D′ may be formed of tissue paper of say 1/3000 of an inch thick, the essential condition being that the ring should be narrow, thin, and resilient, so as to absorb as little energy as possible from the free edge of the diaphragm. Preferably, the ring consists of an extremely thin ring of collodion and is attached to the periphery of the diaphragm and to the removable ring by placing the collodion ring in position and "painting" its edges with liquid collodion which dries up and establishes a firm joint. The thin solid collodion may be formed by spreading out a quantity of liquid collodion on a sheet of glass and allowing the collodion film so formed to solidify by drying.

In Fig. 2 the diaphragm D instead of being controlled or restrained in its movements by a mica disk, is secured to a blade spring F, to which also is secured a carbon disk E^2. The said disk E^2 is peripherally uncontrolled and bears upon carbon balls or granules located within and constituting part of the variable resistance device E. The carbon disk E^2 may be connected to other parts of the blade spring than that shown, say to a point nearer its point of support, if necessary; also any other form of carbon cell may be employed.

In Fig. 3 the diaphragm D is shown connected to the common "button" type of variable resistance device.

In the construction shown in Fig. 4 the carbon cell is of the kind in which the face of the lower block is circularly notched, as shown in dotted lines. The upper block or plate, which may conveniently consist of

carbon coated on the back with a thin layer of copper, has fixed to it a small base plate E^3 from which projects a screw-threaded center post E^4. The conical diaphragm D, instead of being rendered especially stiff at the center by being thicker there, may be of uniform thinness, the great stiffness at the center being obtained, as shown, by raising the center into the form of a cone, the diaphragm being then held in position by the engagement of the flattened apex of this conically formed center with the aforesaid center post E^4. Thus, the whole vibrating mass is of great lightness. The V-shaped channel between the two oppositely directed conical surfaces rests upon the back of the upper block or plate of the carbon cell, pinching the supporting plate of mica between it and the said block or plate.

In the arrangement shown in Figs. 5 and 6 the channel between the two oppositely directed conical surfaces of the diaphragm D is flattened, and the diaphragm is attached at three triangularly spaced points to three carbon cells mounted in an insulating (ebonite) support. These cells may work in series or in parallel, depending upon the manner in which the connections are made. If they work in parallel, the diaphragm may of course have electrical connection with each of the cells, but, if they work in series an insulating washer must be placed between the channel of the diaphragm and one or more of the carbon cells. The means shown in the figure for holding down the diaphragm consist of a plate and post such as those shown in Fig. 4 at E^3 and E^4 respectively, and a spring washer E^5 located beneath the channel of the diaphragm.

The chief feature of constructional importance in the transmitter shown in Fig. 7 is the trumpet-like formation of the main part of the diaphragm.

Fig. 8 represents a further constructional form of transmitter with a trumpet-shaped diaphragm. In this case the carbon cell is shown as hemispherical and the diaphragm is open-ended, the circumference of its smaller end being attached to the circumference of the hemispherical carbon cell. The cover piece B is made to conform in shape to the diaphragm. The conformation of the inner surface of the cover piece B with the contour of the diaphragm is desirable in the case of a transmitter of the design shown in Fig. 8, or in any case where the instrument is rather large and the space corresponding to the depression of the diaphragm is in consequence large, but where the transmitter is of the dimensions corresponding to Fig. 2, for instance, which is full size, the cover piece need not be specially designed in this respect.

As hereinbefore stated, the diaphragm is preferably of graduated thickness from the center outward, the minimum thickness being at the periphery. If desired, several such diaphragms of different diameter may be assembled, and they may differ not only in diameter but also as regards the degree to which they are coned, as shown for example in Fig. 9.

What I claim and desire to secure by Letters Patent of the United States is:—

1. A telephone transmitter comprising a variable resistance device, a casing containing said device, a mouth piece carried by the casing for conveying sound waves into the same, a light, peripherally unrestrained conical diaphragm the thickness of which averages a few thousandths of an inch but decreases progressively toward the periphery, and means securing the diaphragm at its central region to the movable member of the variable resistance device.

2. A telephone transmitter comprising a variable resistance device, a casing containing said device, a centrally perforated cover piece on the casing, a mouth piece carried by the cover piece, a light, peripherally unrestrained, conical diaphragm the thickness of which averages a few thousandths of an inch but decreases progressively toward the periphery, and means securing the diaphragm by its center to the movable member of the variable resistance device.

3. A telephone transmitter comprising a variable resistance device, a casing containing said device, a centrally perforated cover piece on the casing, a mouth piece carried by the cover piece, a peripherally unrestrained, conical diaphragm of aluminium the thickness of which averages two and a half thousandths of an inch but decreases progressively toward the periphery, and means securing the diaphragm by its center to the movable member of the variable resistance device.

4. A telephone transmitter comprising a variable resistance device, a casing containing said device, a mouth piece carried by the casing for conveying sound waves into the same, a light conical metal diaphragm the thickness of which averages a few thousandths of an inch but decreases progressively toward the periphery, means securing the diaphragm by its center to the movable member of the variable resistance device, and a ring of flexible material of the order of one three-thousandths of an inch thick, connecting the periphery of the diaphragm to the interior of the casing.

5. A telephone transmitter comprising a variable resistance device, a casing containing said device, a centrally perforated cover piece on the casing, a mouth piece carried by the cover piece, a conical aluminium diaphragm the thickness of which averages two and a half thousandths of an inch but decreases progressively toward the periphery,

means securing the diaphragm by its center to the movable member of the variable resistance device, a removable flange within the casing, and a ring of flexible material of the order of one three-thousandths of an inch thick connecting the periphery of the diaphragm to the flange.

6. A telephone transmitter comprising a variable resistance device, a casing containing said device, a centrally perforated cover piece on the casing, a mouth piece carried by the cover piece, a conical aluminium diaphragm the thickness of which averages two and a half thousandths of an inch but decreases progressively toward the periphery, means securing the diaphragm by its center to the movable member of the variable resistance device, a removable flange within the casing, and a ring of thin film collodion connecting the periphery of the diaphragm to the flange.

7. In a telephone transmitter, a variable resistance device, a light, conical, peripherally unrestrained diaphragm having its central part coned in the opposite direction to the main part, and means for connecting the central part of the diaphragm to the movable member of the variable resistance device.

8. In a telephone transmitter, a variable resistance device, a light conical diaphragm having its central part coned in the opposite direction to the main part, a base plate secured to the movable member of the variable resistance device, a screw-threaded center post projecting from said base plate, and means for securing the central part of the diaphragm upon the said center post.

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

SIDNEY GEORGE BROWN.

Witnesses:

T. SELBY WARDLE,

W. J. SKERTEN.