No. 835,860. PATENTED NOV. 13, 1906.

A. A. LIND.

MICROTELEPHONE.

APPLICATION FILED FEB. 28, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

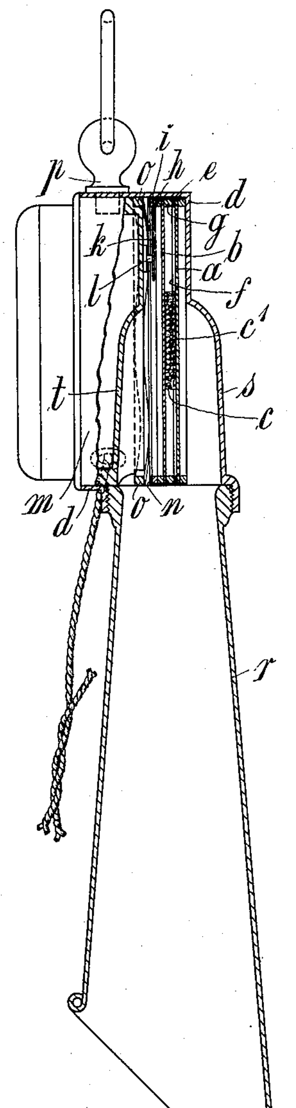
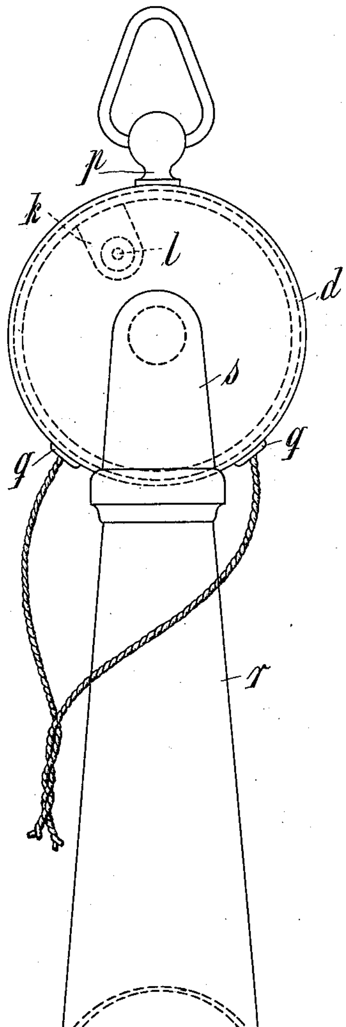


Fig. 2.



Witnesses:

F. W. Wiman

Benjamin H. Holt

Inventor:

Arvid Anderson Lind

by Henry Connett

Attorney

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2 SHEETS—SHEET 2.

Fig. 3.

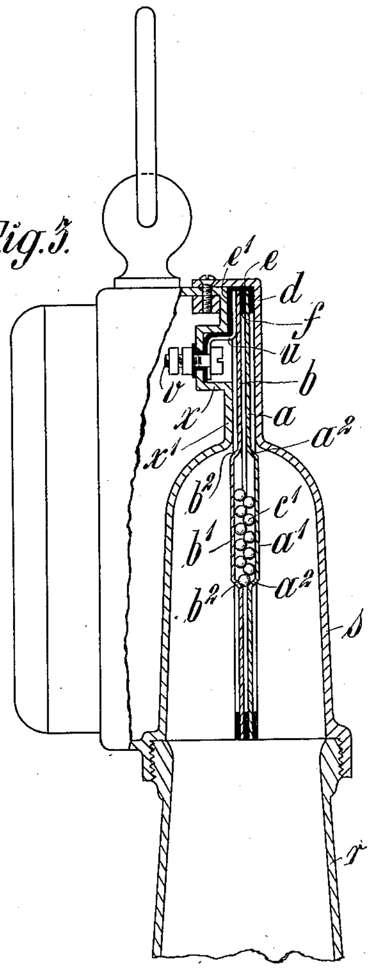


Fig. 5.

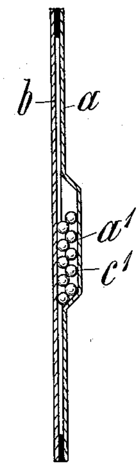
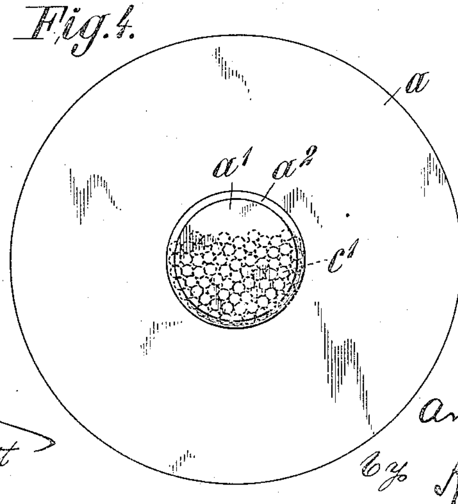


Fig. 4.



Witnesses:

Inventor:

Arvid Anderson Lind

by Henry Connett

Attorney

UNITED STATES PATENT OFFICE.

ARVID ANDERSSON LIND, OF MALMÖ, SWEDEN, ASSIGNOR TO ELEKTRO-MILITÄRA AKTIEBOLAGET, OF STOCKHOLM, SWEDEN.

MICROTELEPHONE.

No. 835,860. Specification of Letters Patent. Patented Nov. 13, 1906.

Application filed February 28, 1905. Serial No. 247,792.

To all whom it may concern:

Be it known that I, ARVID ANDERSSON LIND, a subject of the King of Sweden, and a resident of Kalendegatan 9, Malmö, in the Kingdom of Sweden, have invented certain new and useful Improvements in Microtelephones, of which the following is a specification, reference being had therein to the accompanying drawings.

In many telephone apparatus the transmitter and receiver are mounted on a common handle and form together the so-called "microtelephone." In order, however, that such microtelephones may be practical in every respect, they must be so arranged that speaking directly against the diaphragm of the transmitter is prevented, as otherwise the said diaphragm is struck not only by the sound-waves, but also by air-currents from the mouth, which latter deaden the vibrations of the diaphragm effected by the sound-waves. A still greater drawback of speaking against the diaphragm consists in the saliva and the like being carried into the mouthpiece, the latter being thereby befouled and made injurious to the health. It is true that the disadvantages mentioned above are removed in such microtelephones in which the transmitter and the receiver are mounted in the same casing situated at one end of the handle and said handle being made hollow and adapted to serve as mouthpiece. As, however, these microtelephones hitherto have been constructed the disturbing influence which the transversal local sound-waves produced by the reflection of the sound-waves against the walls of the air-chamber at the diaphragm of the microphone, and especially against the walls of the mouthpiece, have upon the distinctness of the reproduced words is not eliminated. The said disturbing influence, which is perceived as rattling sounds when certain vowels are uttered, while other vowels are deadened, cannot be eliminated by reducing the sensitiveness of the microphone, as in such microphones in which one speaks directly against the diaphragm, as in such case the microtelephone would be unfit for telephoning on long-distance lines. According to my invention the said disturbing influence has been eliminated by combining with the receiver a double-diaphragm transmitter of great sensitiveness in such a manner that the proceeding sound-waves will impinge on both the diaphragms and swing the same toward and from each other, thus producing great variations in the resistance of the microphone, while the transversal local sound-waves have no influence upon the said resistance. The said great sensitiveness of the microphone may be produced in any of the ordinary ways well known by those skilled in the art. According to this invention a microphone of very great sensitiveness is provided by a special arrangement of the diaphragms, making superfluous the ring of felt or other soft material hitherto mounted between the diaphragms for retaining the ordinary carbon grains between the diaphragms. In this manner the diaphragms are permitted to vibrate freely when acted upon by the sound-waves. By the said arrangement of the diaphragms, which will be fully described in the following specification, great variations in the resistance of the microphone are produced during the conversation, while at the same time the resistance of the microphone when in rest—*i. e.*, when conversation is not going on—is reduced compared with the resistance of microphones hitherto employed. Owing to the fact that the intensity of the current through the primary wire of the induction-coil is increased in the said manner and the variations of the said intensity during the conversation are greater than in microphones of the class now in question hitherto employed, the advantage of inductive currents of greater intensity, and consequently a more distinct reproduction of the conversation in the receiver, is gained.

In the accompanying drawings, Figure 1 is a longitudinal sectional view and partly a side view of a microtelephone arranged in accordance with this invention. Fig. 2 is a back view of the same. Fig. 3 is a longitudinal sectional view and partly a side view, on an enlarged scale, of a modified form of the microtelephone, the diaphragms of the microphone being provided with cup-shaped portions. Fig. 4 is a side view of the microphone shown in Fig. 3. Fig. 5 is a cross-section of the diaphragms of a microphone comprising two diaphragms, one of which is arranged in accordance with this invention.

a and *b*, Fig. 1, designate the diaphragms of the microphone, and *c* the ring of felt or other suitable soft insulating material which

forms the cell, containing granulated carbon or carbon grains or balls c'.

In the apparatus shown in Figs. 1 and 2 the diaphragm a is electrically connected with the casing d. The diaphragm b, on the other hand, is insulated from the said casing d by a non-conducting ring e and from the diaphragm a by a non-conducting ring f, mounted between the diaphragm a and a ring g, keeping the diaphragms at a suitable distance from each other. Inside the diaphragm b a conducting-ring h is mounted, and inside the latter a conducting-ring i is provided, having a tongue k. The receiver is arranged in a special casing m, inserted into the casing d and provided with a contact-piece l, bearing against the said tongue k. Between the casing m and a non-conducting ring n, mounted inside the ring i, a springy ring o is provided, portions of which are bent outward from the plane of the ring. Also the rings h and i are insulated from the casing d by the ring e. When the casing of the receiver has been inserted into the casing d and is fixed on its place, which is effected by means of the button p and the sockets q for the cords, which button and sockets are screwed into the said casings, both diaphragms a and b and all the rings are held in position. The diaphragm of the circuits is the same as in ordinary microtelephones. After the primary current has passed from one of the cords through the induction-coil it passes through the contact-piece l, the tongue k, to the diaphragm b, and from the latter through the grains c', the diaphragm a, and the casing d, which is electrically connected with the electric source through another cord. Another pair of cords is connected with the secondary wire of the induction-coil and with the telephone-lines. r is the handle of the apparatus. The said handle is hollow and serves simultaneously as mouthpiece, for which purpose its outer free end is preferably truncated obliquely, as shown. The above-described double-diaphragm transmitter, which is made very sensitive to serve the purpose, is according to this invention so mounted with regard to the hollow handle that the entering sound-waves impinge on both diaphragms with the same force. Thus it will be seen that in the apparatus shown in Fig. 1 the transmitter is mounted in or substantially in the longitudinal center plane of the handle r. In the back wall of the casing d a hollow swelling s is provided, and in the back wall of the casing of the receiver a corresponding cavity t is provided, the said swelling s and cavity t allowing the sound-waves to pass to the diaphragms. The diaphragms a b are caused by the entering sound-waves to swing toward and from each other, thus producing great variations in the resistance of the transmitter.

In the microtelephone shown in Fig. 3 the diaphragms a and b are each provided with a central cup-shaped portion a' b', formed by the diaphragms being bent outward. The said cup-shaped portions form together a cell containing the ordinary carbon grains or balls c'. Owing to the said cup-shaped portions the diaphragms may be mounted close to each other, separated at their edges only by a thin ring f, of paper or other insulating material. Consequently the grains c', having a diameter greater than the distance between the diaphragms, are retained in the said cell between the diaphragms without the aid of the ring of felt hitherto employed. Thus it will be seen that the deadening effect to which the diaphragms of microphones provided with such a ring of felt or other similar material always have been subjected, owing to the bearing of the said ring upon the diaphragms, does not exist in microphones in which the diaphragms are arranged as shown in Figs. 3 and 4. In consequence hereof the diaphragms can swing more freely than in microphones as hitherto constructed. Moreover, the diaphragms can be placed closer to each other, the access of the sound-waves to the diaphragms being thus facilitated. The bottom wall of the cup-shaped portions a' b' is preferably made plane, as shown, so that the sound-waves will impinge on the said walls under the same conditions as on the other parts of the diaphragms, and the diaphragms will swing like ordinary plane diaphragms. The part a^2 b^2 of each cup-shaped portion connecting the bottom wall with the diaphragm itself is preferably made straight in cross-section and extends from the bottom inward in an oblique direction toward the edge of the diaphragm, so that the parts a^2 b^2 of the diaphragms form together a corner. In the said corner a row of carbon grains or balls will gather, which grains all bear upon both diaphragms and form a bridge for the primary current. Consequently there are at each ball of the said row only two contact-points for the current to pass. Above the said row the grains will be seated, as shown in Fig. 3, so that there are three contact-points at least at each pair of grains, as in microphones hitherto employed. The number of grains arranged in series in the upper part of the cell is evidently dependent on the distance between the bottom walls of the cell and may be more than two. In any case there will be only one grain in the lowermost row at each cross-section of the cell with two contact-points, while, on the other hand, there are two grains at least with three contact-points at the lower part of the cell in microphones hitherto employed. Owing to this fact, the resistance of the microphone when in rest will be reduced, and thus the intensity of the current increased.

In the microphone shown in Figs. 3 and 4 the grains or balls in the cell during the

swinging movement of the diaphragms toward and from each other will be lifted by the oblique side walls a^2 b^2 acting upon the lowermost row of grains and pressing the same upward. The variations of the resistance of the microphone are consequently effected not only by the pressure between the grains and between the grains and the diaphragms being increased and decreased, but also by the moving of the grains in relation to each other and to the diaphragms, which results in great variations in the resistance. As well known, the intensity of the inductive currents generated in the secondary wire of the induction-coil is dependent on the total variation per second in the flow of the lines of magnetic force. The said variation of the lines of magnetic force, on the other hand, is dependent on the variations of the current generating the same. At a certain number of vibrations the said variation of the lines is directly proportional to the amplitude of the variation of the current. The said variation of the current, on the other hand, is directly proportional to the intensity of the current through the microphone when at rest and approximately proportional to the variation of the resistance of the microphone. From this it will be seen that the more intense the current through the microphone when the microphone is at rest and when at the same time the variations of the resistance of the microphone are great the more intense inductive currents are produced and the better reproduction of the conversation is attained. The said conditions for a powerful and distinct reproduction of the conversation are fulfilled in the microphone now in question, as has been shown above. The diaphragm *a* is in leading connection with the casing *d*, and the diaphragm *b* is insulated from the same by non-conducting-rings *e* and *e'*. A metal strip *u* is mounted at its one end between the diaphragm *b* and the ring *e'*, and its other end is fixed, by means of a screw *v*, in a cavity *x*, formed in an inner wall *x'* of the casing. The said strip and the screw are insulated from the casing. The receiver is of any known construction, and is therefore not shown or described. The diagram of the circuits is the same as in Fig. 1. After the primary current has passed through the induction-coil it passes through the strip *u* to the diaphragm *b* and from the latter through the grains *c'*, the diaphragm *a*, and the casing *d*.

In the microphone schematically shown in Fig. 5 one diaphragm only is provided with a cup-shaped portion *a'*, the other diaphragm being plane. In the construction shown in Fig. 5 the cell for containing the carbon grains *c'* is shaped substantially in the same manner as shown in Figs. 3 and 4. Consequently the manner of operation is substantially the same as stated above with reference to Figs. 3 and 4, and advantages are gained corresponding in some degree to those gained in the construction shown in these figures.

In the practical execution of the invention the arrangements shown in the drawings may be modified in many respects without exceeding the limits of the invention stated in the following claims. The diaphragms and grains may be of carbon or any other suitable material which will conduct the current, as, for instance, metal.

As microtelephones arranged in accordance with this invention and employed in practice have shown, these instruments are fully suitable also for telephoning very long distances. The rattling sounds or the resonance existing in apparatus of this type hitherto employed, especially when words with the vowels "a" and "o" are uttered, will cease entirely when a double-diaphragm microphone mounted as stated above is employed, while no deadening of such vowels as "u," "e," and "i" has been perceived. The explanation of the great distinctness of the reproduction of the conversation gained by microtelephones constructed in accordance with this invention is found in the fact that the microphone can be made extremely sensitive without the local transversal sound-waves—*i.e.*, waves perpendicular or substantially perpendicular to the longitudinal direction of the mouthpiece and generated through interference owing to the reflection of the sound-waves against the walls *s* and *t*, Figs. 1 and 2, and *s* and *x'*, Fig. 3, and especially against the walls of the mouthpiece *r*, having any disturbing influence upon the vibrations of the diaphragms. It may be observed that the said sound-waves are synchronous, and consequently when acting upon the diaphragms they cause both the same to swing in the same direction, so that the diaphragms keep company. Consequently the vibrations of the two diaphragms caused by the local transversal sound-waves will produce no variations in the resistance of the microphone, and consequently no disturbing by-sounds during the telephoning. The vibrations of the diaphragms, which produce the variations in the resistance, are consequently effected exclusively by the proceeding sound-waves, which, as mentioned above, cause the diaphragms to swing toward and from each other. As microtelephones constructed in accordance with this invention are fully suitable for telephoning on long-distance lines and besides fulfil all requirements sanitarily and can be manufactured very cheap, they are practical in every respect.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In microtelephones, the combination of a casing, a hollow handle for the same serving as mouthpiece, a receiver mounted in

said casing, and a double-diaphragm transmitter in the casing having its center plane, which is parallel with the diaphragms, situated substantially in the center plane of that end of the said handle on which the casing is mounted, substantially as described and for the purpose set forth.

2. In microtelephones, the combination of a casing, a hollow handle for the same serving as mouthpiece, a receiver mounted in said casing, and a double-diaphragm transmitter in the casing, the diaphragms of which are constructed to form a cell containing grains and have the center plane, which is parallel with the diaphragms, situated substantially in the center plane of that end of the said handle on which the casing is mounted, substantially as described and for the purpose set forth.

3. In microtelephones, the combination of a casing, a hollow handle for the same serving as mouthpiece, a receiver mounted in said casing, and a double-diaphragm transmitter in the casing, the diaphragms of which are constructed to form cells containing grains and have the center plane, which is parallel with the diaphragms, situated substantially in the center plane of that end of the said handle on which the casing is mounted, substantially as described and for the purpose set forth.

4. In microtelephones, the combination of a casing, a hollow handle for the same serving as mouthpiece a receiver mounted in said casing, and a double-diaphragm transmitter in the casing, each of the diaphragms of which are constructed to form grain-containing cells with plane bottoms and have the center plane, which is parallel with the diaphragms, situated substantially in the center plane of that end of the said handle on which the casing is mounted, substantially as described and for the purpose set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ARVID ANDERSSON LIND.

Witnesses:

E. HEDENSKAG,

A. LARSON.