Dec. 6, 1927. 1,651,531

M. L. MARTUS ET AL

RADIO TELEPHONE RECEIVER

Filed May 16, 1923 2 Sheets-Sheet 1

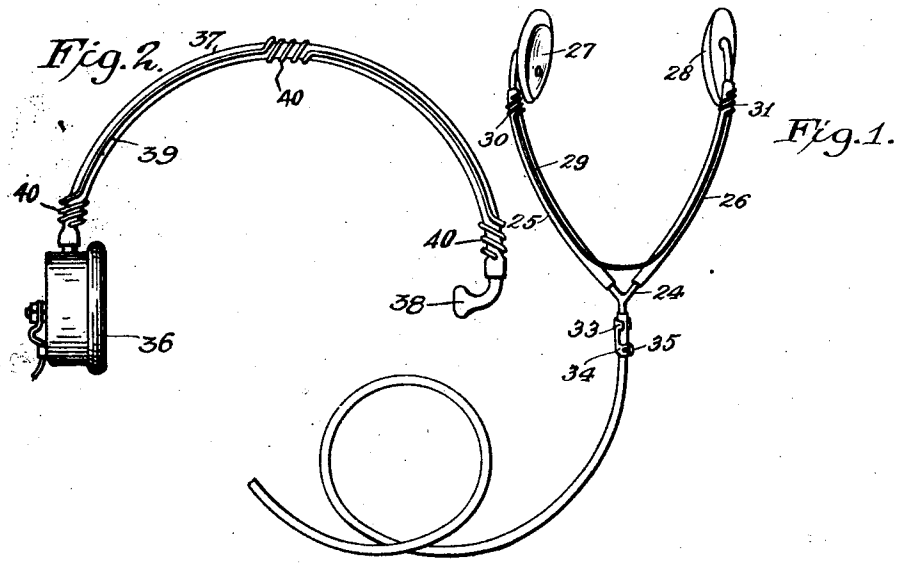


Fig. 1.

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Fig. 3.

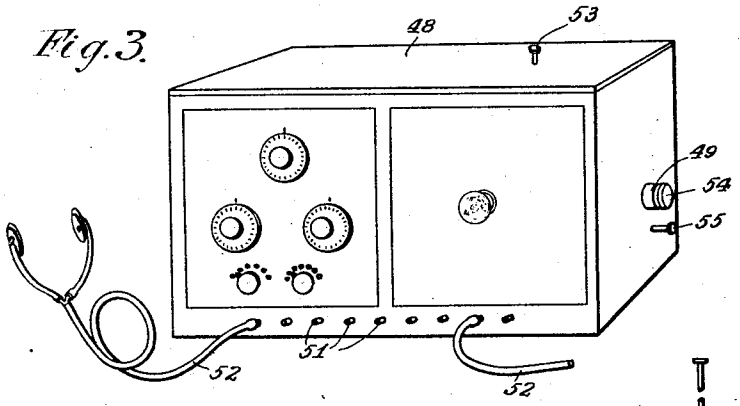


Fig. 4.

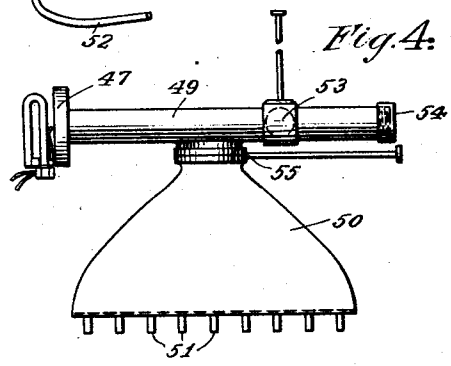


Fig. 5.

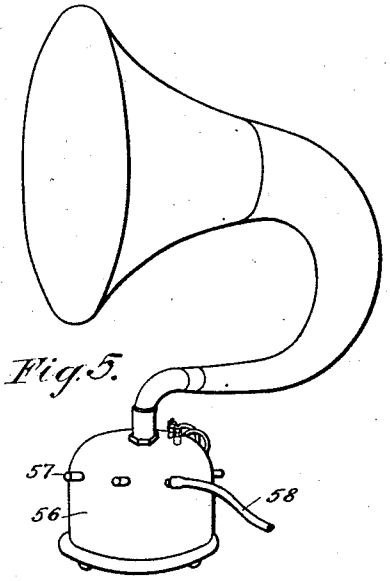


Fig. 6.

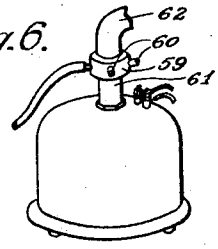
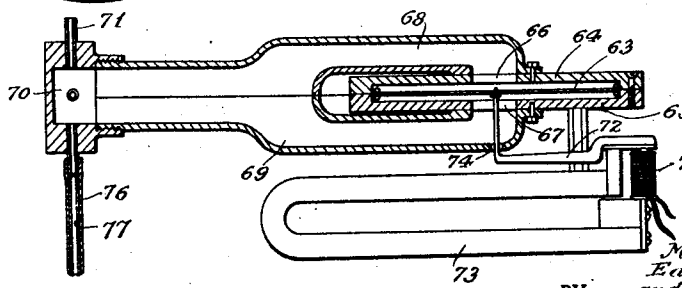


Fig. 7.



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UNITED STATES PATENT OFFICE.

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RADIO TELEPHONE RECEIVER.

Application filed May 16, 1923. Serial No. 639,263.

This invention relates to sound receiving devices, particularly for use in the reception of sound generated by the vibrating diaphragms of telephone receivers used in connection with radio receiving apparatus.

It is desirable when tuning in a distant station, or during the reception of a radio concert to use the full amplification of the receiving set by plugging in the ear phones in the last stage, but owing to the severe strain on the auditory nerve connecting with the tympanic membrane of the ear, due to howling and static, a loud speaker is generally used to reproduce the sound. This however is unsatisfactory, because of the great amplification of undesirable sounds and the annoyance, before the desired station is properly tuned in, to other persons in the room.

In the case of the ear phones, the air gap between the diaphragm and the tympanic membrane is made as small as possible, the sound waves being propagated by molecular motion, the particles of the air which fill the cavity of the ear are moved forward each impinging on that immediately before it and then rebounding, finally being driven against the tympanic membrane, the vibration of which is transmitted to the auditory nerve, and thence to the brain, which takes cognizance of the sensation. By this alternate movement of advance and rebound, the air is alternately condensed and rarefied, causing a severe strain on the ear drum, due to this unnatural method of applying mechanical vibrations directly to the ear, without sufficient air intervening to cushion the hammering blows of the particles of air. Periodic vibrations always yield musical sounds, being smooth and agreeable to the ear, while on the other hand, noises, or non-periodic vibrations, produce on the tympanic membrane a kind of jolting sensation of irregularly recurring shocks.

A noise thus affects the auditory nerve painfully, just as a flickering light gives rise to painful sensation in the nerves of sight. Nature has made the sensation of hearing very delicate to receive sound from a distance, and it is upon this principle that our invention is based.

If the atmospheric conditions are favorable to the reception of radio communications, a loud speaker may be used, sufficient air intervening to mellow the sound and eliminate all strain on the tympanic membrane of the ear. The objections to loud speakers are however innumerable, some of which may be mentioned as follows: the first cost of the receiving set equipped with sufficient amplification to operate a loud speaker—the excessive amplification of static and hissing mechaical noises—the ideal atmospheric conditions necessary to operate properly—and the inherent metallic sound which is present, even under the very best circumstances.

We have discovered that by supplying a tube, such as rubber, to conduct the sound from the receiver daphragm to the ear drum, all of the advantages of a loud speaker are obtained, with the added advantages of increasing the range of the receiver by reducing interfering noises, mellowing the sound and eliminating the metallic noises of the diaphragm, thus allowing use of full amplification of the receiving set to be applied directly to the ears. This is principally due to the cushioning effect of the column of air contained in the tube.

The law that intensity of sound decreases in proportion to the square of the distance, does not apply to the case of tubes. The sound waves in that case are not propagated in the form of increasing concentric spheres, and due to the smooth, uniform and unobstructed inner wall of the tube, sound waves can be transmitted to a great distance with out any perceptible alteration or reduction.

We have also found that sound waves of high frequencies are propagated in tubes less easily than those of audio frequencies. This condition makes our invention particularly adapted for radio reception.

An object of the invention therefore, is to provide a sound receiving device, especially for radio reception, having tubes for conducting the sound from the diaphragm of the receiver to the ears of the listeners.

A further object is to provide a listening device which may be used with comfort and convenience, as distinguished from the present head-phones, which impose approximately one pound of dead weight on the head of the user, and cannot be used when a hat is worn, or a coiffure in the case of women.

A still further object is to eliminate the danger from lightning, this device being in the nature of an insulator. Also static noises of high intensity, which are very injurious to the ears are made harmless by the

cushioning effect of the column of air contained in the tube.

Another object is to provide a construction by which the vibrations at each side of the diaphragm of the receiver are utilized.

Still another object is to provide means by which the tubes may be used for carrying communications directly from the speaker to the listeners, as when receiving broadcasting in a large hall or church, such communication being auxiliary to the radio conduction. This method is especially advantageous for deaf persons.

With the above and other objects in view, embodiments of our invention are shown in the accompanying drawings, and these embodiments will be hereinafter more fully described with reference thereto, and the invention will be finally pointed out in the claims.

In the drawings:

Fig. 1 is a perspective view showing a listening device according to one embodiment of our invention;

Fig. 2 is a plan view of a modification, in which a single ear phone is provided with an extension, according to our invention, to form a head-set;

Fig. 3 is a perspective view of a radio receiving cabinet provided with a still further modification, in which a single loud-speaker within the set is provided with a series of individual sound tubes, according to our invention;

Fig. 4 is a plan view of the device;

Fig. 5 is a perspective view of a loud-speaker, and in which the sound chamber is provided with a series of outlets for connecting sound tubes according to our invention;

Fig. 6 is a perspective view of a loud speaker, provided with a further modification of our device; and

Fig. 7 is a sectional view of a still further modification, in which the diaphragm of the loud speaker is provided with sound outlets at each side.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring particularly to the modification shown in Fig. 1, the device illustrated therein includes an elongated rubber tube 23 having one end to be placed in communication with a sound chamber, the other end being provided with a tubular Y-connection member 24, to which a pair of branch tubes 25 and 26 are connected, these tubes being provided at their ends with ear pieces 27 and 28 of such size as to cover the ears and rest against the sides of the head. The edges of the ear-pieces are rounded and projected in a manner to conform to the top of the ear, the depth of the concavity at the inner side being proportioned to bridge the ear and relieve it of all lateral pressure. A bowed spring wire 29 is connected at its coiled ends 30 and 31 to the tubes 25 and 26 for the purpose of holding the ear pieces in yieldable engagement with the ears of the user.

In order to enable the listeners to modulate or cut off the sound in their individual tubes a modulating device is provided adjacent the Y-connection, consisting of a spring clamp portion 33 adapted to be clipped over the end of the Y-connection, and a ring portion 34 embracing the rubber tube adjacent the connection and provided with a set-screw 35, which may be adjustably pressed into engagement with the tube to modulate or cut off the sound.

By mounting receivers to which the tube 23 may be connected, on the panel of a receiving set the length of the connecting wires is reduced to a minimum, and as a number of listeners may be accommodated with the single pair of receivers, the first cost of the set is considerably reduced. It has been found that accommodating both ears of eight listeners from one receiver, does not perceptibly reduce the intensity of the sound.

In Fig. 2 we have illustrated a type of receiver, according to our invention, by means of which a single receiver 36 is employed, and is adapted to be engaged directly with one ear of the listener, in the usual way to receive the vibrations from one side of the diaphragm. The air space at the other side of the diaphragm is connected by a rubber tube 37 to an ear plug 38, adapted to be inserted in the other ear, so that the vibrations at each side of the diaphragm are utilized, and the equivalent of a two-phone head-set is obtained, at considerably less cost and with greater comfort to the wearer and superior sound reception. A stiffening wire 39 having a series of tube embracing coils 40 is provided upon the tube.

The modification of our invention illustrated in Figs. 3 and 4 consists of a loud speaker 47 provided within a radio receiving cabinet 48, and having a sound conduit 49 provided with a flared sound amplifying chamber 50, this chamber being provided along its forward edge with a series of outlet tubes 51 to which the elongated individual listening tubes 52 are attached. The sound conduit 49 is provided with a control valve 53 for modulating or cutting off the sound passing therethrough, and at its end with a removable cap 54, which may be removed to enable a listener to hear the sounds directly from the loud-speaker. A control valve 55 is provided in the throat of the sound amplifying chamber 50, for modulating or cutting off the sounds passing therethrough.

In Fig. 5 there is illustrated a further modification, in which the casing 56 of a loud speaker of the amplifying horn type

is provided with a series of sound outlets 57, to which individual listening tubes 58 may be attached. In the form shown in Fig. 6 a sound chamber 59 provided with a series of radial outlets 60 is placed in the sound tube 61 at its juncture with the amplifying horn 62.

The modification of the invention illustrated in Fig. 7 consists of a loud speaker, in which the sound vibrations at each side of the diaphragm are carried through a single conduit to a sound amplifying chamber. The diaphragm 63 is mounted between a pair of sound box members 64 and 65, the outlets 66 and 67 of which are in communication with the conduits of a pair of conduit members 68 and 69 clamped together and forming a yoke-shaped conduit, the passages at each side of the diaphragm merging into a single passage, at the end of which a sound concentrating chamber 70 having a series of radial outlets 71 is provided. The vibrating lever arm 72 is supported by magnetism upon the end of the permanent magnet 73, and extends through an opening 74 in the conduit member 68 to the center of the diaphragm, and is adapted to be vibrated by a solenoid 75 engaged at its outer end. With this device the vibrations at each side of the diaphragm are carried to the sound chamber 70, and thence to the several listeners through the individual sound tubes 76 connected to the outlets 71.

Our tubular system may also be used to amplify the sound, depending upon the character of the gases or other sound conductors used to conduct the sound in the tube, as it is well known that gases heavier than air, or moist air, are better sound conductors than the ordinary atmosphere and better transmission of sound may therefore be obtained through a tube filled for instance with moist air. In Fig. 7 we have shown means for carrying out this idea, the tube 76 being provided with an inner lining 77 of moisture absorbing material, as felt.

In hospitals and infirmaries, where a loud speaker would be obnoxious, sound tubes according to our invention could be carried from the loud speaker of a receiving set provided at some central point removed from the patients, to outlets at the costs, making the reception selective by means for cutting off or modulating the sound. The cost would be very low, considering the number of persons served.

Our invention will change the equipment of a receiving set by mounting one loud speaker, or a receiver, in the receiving set, with outlets to receive one end of each listening tube; dispensing with head-sets, their jacks and leads; and permitting modulation of the sound as desired. Long distance stations may be tuned in with less trouble and interference than heretofore, and a more faithful reproduction of the sound is received. The device will operate satisfactorily when the intensity of the sound is insufficient to ordinarily operate a loud speaker.

The cost of head phone sets to accommodate as many as three listeners is very often as much or more than the cost of the whole receiving set. This is especially true in the case of crystal receiving sets. The manufacturing cost of our invention, in any of its several modifications, is very low in both labor and material.

We have illustrated and described preferred and satisfactory embodiments of our invention, but it will be obvious that changes may be made therein, within the spirit and scope thereof, as defined in the appended claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In radio apparatus, a receiver having a diaphragm, means for vibrating said diaphragm, a sound concentrating chamber element, sound conduit members at each side of said diaphragm extending to said chamber element, and means for conducting sound vibrations from said chamber to the ears.

2. In the art of transmitting sound by radio, a sound receiver, an ear-piece, an elongated tubular member connecting said receiver to said ear-piece and means within said tube adapted to render the air therein moist.

3. In the art of transmitting sound by radio, a sound receiver, an ear-piece, an elongated tubular member connecting said receiver to said ear-piece, and a moisture absorbing inner lining in said tube adapted to render the air therein moist.

4. In a sound reproducer, a sound box, a diaphragm arranged in the sound box, means for gathering sound reproductions from each side of the diaphragm, a chamber communicating with and receiving the sound from said means, and a plurality of means for carrying sound from said chamber to individual listeners.

Signed at Waterbury in the county of New Haven and State of Connecticut this 14th day of May, A. D. 1923.

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