

Feb. 14, 1933.

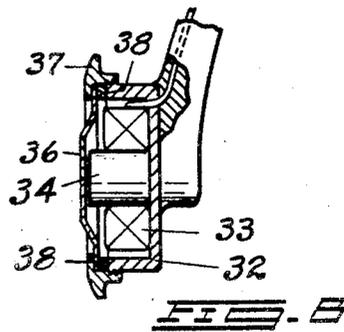
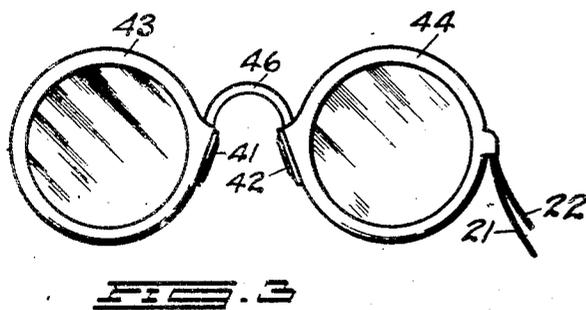
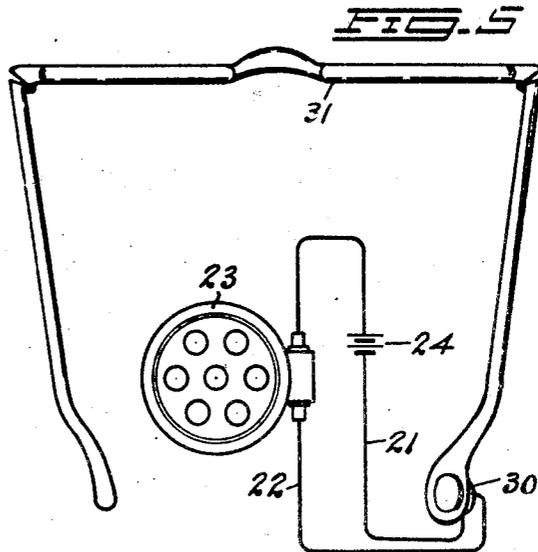
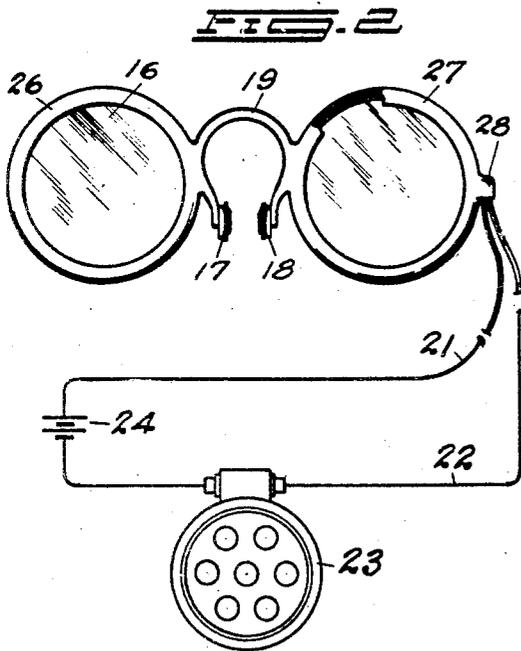
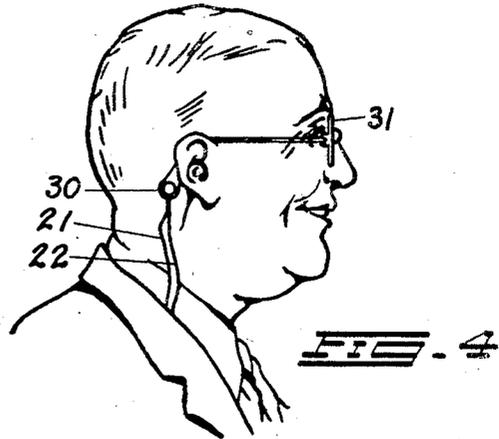
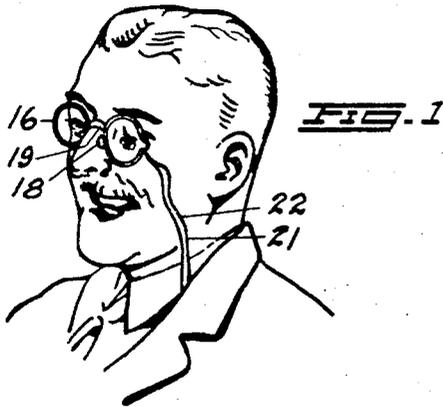
W. G. G. BENWAY

1,897,833

AUDIPHONE

Filed Jan. 26, 1931

3 Sheets-Sheet . 1



INVENTOR
William G. G. Benway
 BY *G. Wright Arnold*
 ATTORNEY

Feb. 14, 1933.

W. G. G. BENWAY

1,897,833

AUDIPHONE

Filed Jan. 26, 1931

3 Sheets-Sheet 2

FIG. 7

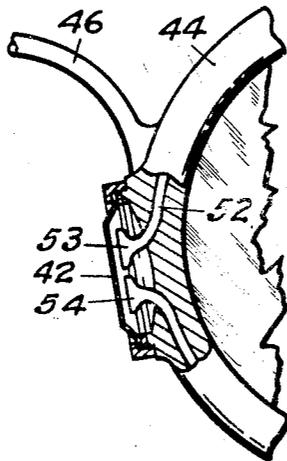
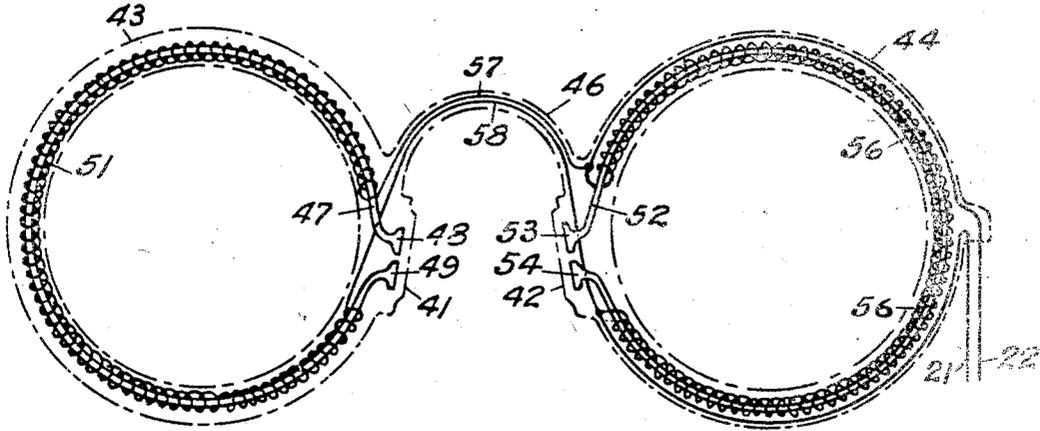


FIG. 8

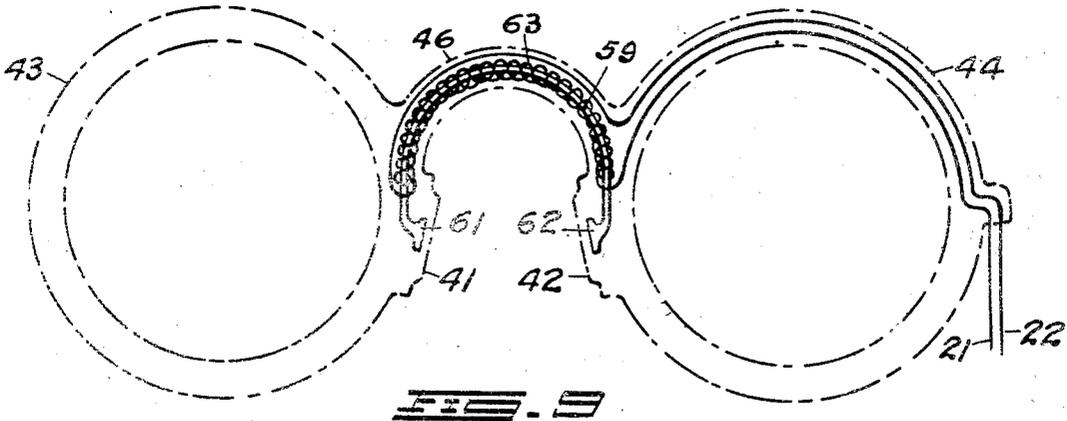


FIG. 9

INVENTOR
William G. G. Benway
BY *E. Wright Arnold*
ATTORNEY

Feb. 14, 1933.

W. G. G. BENWAY

1,897,833

AUDIPHONE

Filed Jan. 26, 1931

3 Sheets-Sheet 3

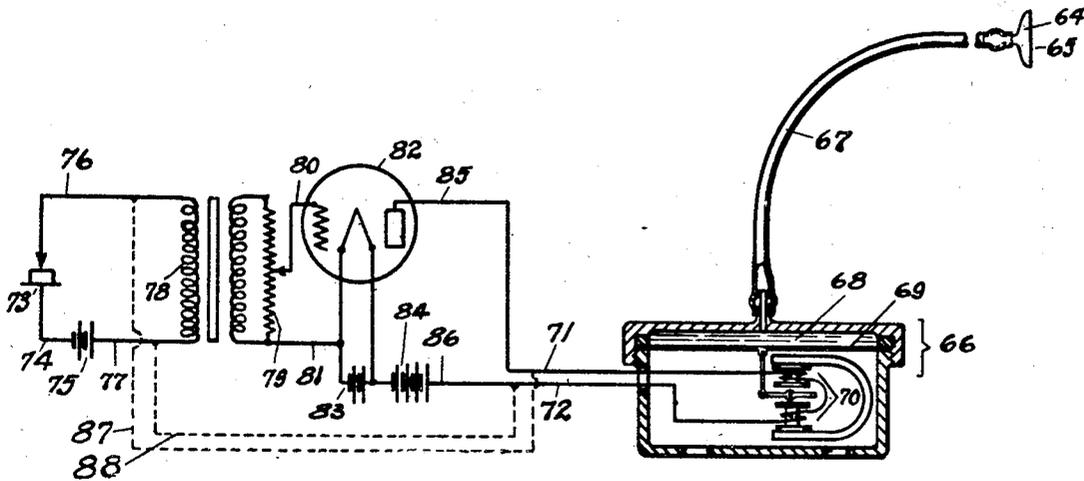
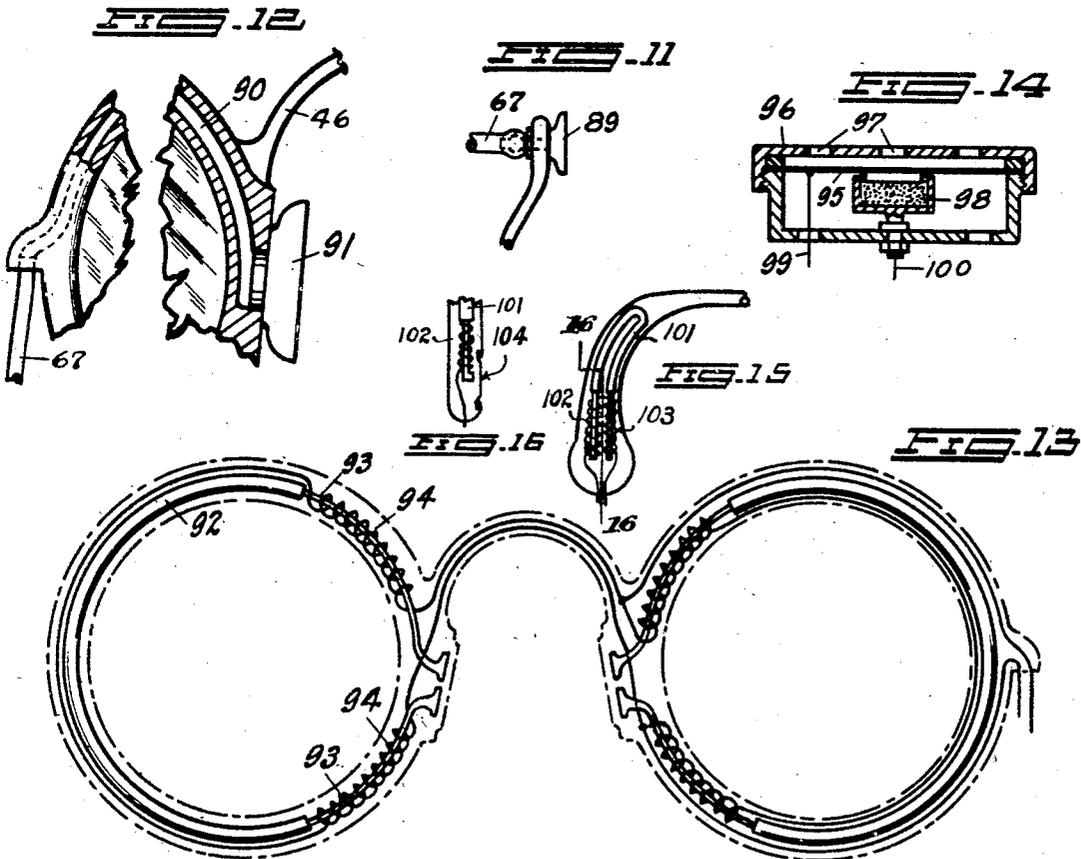


FIG. 10



INVENTOR
William G. G. Benway
BY *Albright Arnold*
ATTORNEY

UNITED STATES PATENT OFFICE

WILLIAM G. G. BENWAY, OF SEATTLE, WASHINGTON

AUDIPHONE

Application filed January 26, 1931. Serial No. 511,329.

My invention relates to telephonic devices for assisting or enabling deaf persons, or persons whose hearing is impaired, to hear, such devices being commonly known as audi-
 5 phones. More particularly, my invention relates to a special form of audiphone and to one that conceals its true character and purpose.

In the large percentage of cases deafness
 10 is not accompanied by impairment of the auditory nerve or those parts commonly known as the internal or middle ear, and is due largely to defects in the ear structure other than said internal ear parts. If sound
 15 vibrations can be made to act on the auditory nerve or the internal ear parts in such cases, hearing is possible or is reestablished. Accordingly, I have found that when a vi-
 20 brating member is placed and held in contact by means of a spectacle frame with one or more bones of the head such as the mas-
 25 toid temporal bone or the nasal bone, i. e., with the skin over said bones, the vibrations will be effectively transmitted or conducted
 30 through the bones of the head to the auditory nerve or internal ear, and hearing is established. It will be understood that in providing a means to overcome deafness, bone
 35 conduction of the sound vibrations is only a small portion of the problem. Those afflicted with deafness are peculiarly sensitive
 40 and rather than to employ devices which admittedly will enable them to hear but which advertises and reveals most emphatically
 45 their affliction even unto strangers who would not otherwise know of the affliction, those having difficulty in hearing often will do without any device whatever. Therefore,
 50 the object of my invention is to provide a device which will cause vibrations, induced by sound waves to be transmitted through the bones of the head to the internal ear or auditory nerve by a vibratory member carried by or embodied in an eye spectacle
 45 frame, said frame not only functioning as a lens supporting means and as a means of supporting the vibrating means against a suitable bone of the head or as a means in which the vibrating means may be formed or
 50 incorporated, but as a means of concealing

the pressure of those parts of the audiphone necessarily disposed in relation to the head.

In general, deafness may be said to be of two kinds, first, due to impairment of the auditory nerve, and second stoppage causes.
 55 Stoppage embodies a group of causes, the principal one of which is the stopping of the eustachian tube due to catarrhal troubles. The impairment of the auditory nerve generally occurs later in life or in elderly people.
 60 In hearing of this character, the bone conduction likewise proportionally decreases, that is, if they lose fifty per cent of the hearing through the ear, then likewise the bone conduction decreases fifty per cent.
 65 Where the impairment is due to causes of the second type, namely, stoppage, then as the hearing through the ear is impaired the bone conduction is increased. In other
 70 words, in the second type, it would seem that the auditory nerve seeks external contact in one way or the other and the one route through the ear being blocked, takes ad-
 75 vantage of the circuitous route of the bone. Impairment of hearing due to the second type of cause is principally prevalent in people of younger years or middle life. There-
 80 fore the solution of the hearing problem provided by the device embodied in my invention is especially important to this group
 85 who are in the productive years of their life and to whom their hearing is economically and socially of the utmost importance. This group is particularly sensitive relative to wearing any device that conspicuously an-
 90 nounces, even to strangers, that they are thus afflicted. Nevertheless, my device likewise solves the difficulties of those who have the first type of impaired hearing.

One of the problems solved by my inven-
 90 tion is the adjustment of the impulse to proportions that will solve both types of impaired hearing, or loss of hearing. My device makes provision for having the necessary increase of area of contact to provide
 95 for the requirement of necessary magnitude of impact of the vibrating member and does this by means that conceals its true character.

Another object of my invention is to pro- 100

vide a device in the form of a pair of spectacles or eyeglasses which will be of sufficient lightness of weight as not to be uncomfortable to the wearer and at the same time provide for the transmission of impulses of such magnitude as to cause bone conduction of said impulses, and at the same time provide for the practical concealment of the audiophone.

Prior devices for aiding the hearing have been awkward and cumbersome in appearance and for this reason have been a source of great inconvenience to users. The parts of my device which are exposed to view can have the appearance of a pair of eyeglasses, or spectacles, or can be combined with a pair of eyeglasses, or spectacles, thus eliminating the disadvantages in appearance of devices heretofore known. Accordingly, the device embodying my invention is of a character which can be supported by the frame of a pair of eyeglasses, or spectacles, in such a manner that its presence will not be noticed without close scrutiny.

Another object of my invention is to provide a novel device for transmitting sound through the bones of the head to the auditory nerve or internal ear.

Since sounds are of all degrees of intensity a further object of my invention is to provide various methods of amplifying and controlling the same so that a distant speaker may be heard or an unduly loud sound may be appropriately reduced, said methods including a liquid connection between the microphone means and the vibratory member disposed in or in connection with the spectacles, or eyeglasses.

A still further object of my invention is to provide an audiophone of a character which does not obstruct the ears but leaves them entirely unencumbered to function in any degree of which they are capable, thus providing a supplementary channel over or through which the sound waves may be transmitted to the internal ear or auditory nerve, and preventing through nonuse or atrophy, loss of the normal functioning of the ear to whatever extent it is capable.

The above mentioned general objects of my invention, together with others inherent in the same, are attained by the device illustrated in the following drawings, the same being preferred exemplary forms of embodiment of my invention, throughout which drawings like reference numerals indicate like parts.

Figure 1 illustrates the appearance of one embodiment of my invention when in use, the device being shown in the form of pince-nez eyeglasses.

Fig. 2 is a front view of the device shown in Fig. 1, illustrating also the manner in which the device can be connected to a suit-

able sound reproducing unit, as, for example, a microphone.

Fig. 3 is a modification of the pince-nez type of the device.

Fig. 4 illustrates a modification of my invention as applied to a pair of bow type eyeglasses.

Fig. 5 is a top view of the device illustrated in Fig. 4, together with a sound reproducing unit, as, for example, a microphone.

Fig. 6 is a detail cross sectional view of the receiving mechanism, or vibrating member, of the device shown in Figs. 4 and 5.

Fig. 7 is a diagrammatical view of the modification shown in Fig. 3.

Fig. 8 is a detail view, partly in section, of the vibratory member of the modification shown in Fig. 3.

Fig. 9 is a front view of a modification having electromagnetic means mounted in the nose bridge of a pair of eyeglasses.

Fig. 10 is a diagrammatic view of a modified form of a device embodying my invention, together with liquid operated vibrating member and electric circuit, said circuit embodying audion-tube amplifying means.

Fig. 11 is a view of a modified bow supported vibrating member.

Fig. 12 is a view of a modified form of nose type of spectacle having hollow frames.

Fig. 13 is a view illustrating the preferred form of combined fixed and electromagnetic means.

Fig. 14 is a view in cross section of a microphone.

Fig. 15 is a modified form of the end portion of a bow member of a spectacle frame provided with an electromagnetic and diaphragm; and

Fig. 16 is a transverse view on the dotted line 16, 16 of Fig. 15.

In one preferred form the invention comprises a vibratory member disposed adjacent to or in intimate contact with one of the bones, i. e., the skin over said bones, of the head and electromagnetic means for vibrating said member in accordance with sound waves. Preferably, the vibratory member is mounted on, or incorporated in, a pair of eyeglasses in such a position that it is practically unnoticeable, parts of the device being disposed within the bows, rims, or nose bridge of the eyeglasses, or nose gripping parts, all of which parts are herein referred to as the spectacle frame.

Referring now to the drawings, and first to Figs. 1 and 2 thereof, I have shown an audiophone associated with a pair of eyeglasses 16 of the pince-nez type. A pair of miniature receiving, or vibrating means 17 and 18 are mounted on nose bridge 19 of eyeglasses 16 and are preferably so disposed that the vibratory member, or diaphragm,

of each receiver bears against the nasal bone, i. e., the skin over said bone, of the wearer.

Electrical conductors 21 and 22 are employed for connecting receivers 17 and 18 in an electrical circuit with a microphone 23, or other suitable sound pick-up device, and a source of electrical energy, such as a battery 24, can also be included in the circuit. The rims 26 and 27 of the eyeglasses can be made of moldable material and conductors 21 and 22 leading to the receiver can be embedded therein. If desired, however, the rims can instead be made hollow or have a groove therein to form a conduit for the conductors. Nose bridge 19 of the eyeglasses can be formed in any desired manner and is preferably provided with a groove or is made hollow to hide the parts of the conductors extending between receivers 17 and 18. Microphone 23 is adapted to be secured in the usual manner on the chest of the user and the visible portions of conductors 21 and 22 extending to the microphone are preferably covered by a suitable ribbon and may enter the eyeglasses near one end 28.

In the operation of the device illustrated in Figs. 1 and 2, sound waves impinging on microphone 23 set up corresponding current variations in conductors 21 and 22 which cause the vibratory members, or diaphragms, of receivers 17 and 18 to vibrate in accordance therewith in a manner well known in the art. These vibrations are impressed on the nasal bone of the wearer as the diaphragms bear upon or contact directly the nose or bone portion which is designed to be contacted and are transmitted from this bone through other bones of the head to the middle ear or auditory nerve. Where the hearing of a person is only partially impaired, some sound will also reach the auditory nerve through the ears, thus reinforcing the sound from the audiphone. Prior devices of this character commonly employed a receiver which was placed over or in the ear, thereby obstructing passage of all sounds through the ear except that from the receiver. With my device the sound passages of the ear are left unobstructed and the sounds from the audiphone are added to the sounds received naturally, rather than being substituted therefor. Thus, the device embodying my invention operates in a manner which does not tend to result in non-use of the ear, i. e., atrophy of the external, or external and middle, ear but results in actual stimulation of those impaired portions.

It is not necessary that the receiving device of the audiphone be placed adjacent the nasal bone and, if desired, this part of the device can be located in a position where it bears against some other bone of the head.

For example, in Figs. 4 and 5 I have shown a receiver 30 mounted on one of the bows of a pair of eyeglasses 31 in such a position that it abuts against the mastoid temporal bone directly behind the ear. This arrangement is particularly suitable for women, since the receiver can be effectively hidden by the hair. It is to be understood that a receiver of this type can be placed on the ends of either one or both bows of the eyeglasses, as may be desired.

In Fig. 6 I have shown in detail one form of receiving device which is suitable for use in the embodiments illustrated in Figs. 4 and 5. Disposed within a casing 32 is an electromagnet comprising a coil 33 and a core 34 of magnetic material. Preferably core 34 is permanently magnetized. Disposed adjacent the electromagnet is a diaphragm 36 which can be held in place by a flanged annular ring 37 having a threaded engagement with casing 32. If desired, diaphragm 36 can be dished outwardly as shown, in order to make more intimate contact with the surface against which it rests. Diaphragm 36 is adapted to be vibrated in accordance with the sound waves in a manner well understood in the art. For enabling greater movement of diaphragm 36 an annular resilient member 38, of soft rubber or the like, can be disposed between the peripheral edge portion of diaphragm 36 and casing 32 on one or both sides of the diaphragm.

In Fig. 3 I have shown a modification in which a pair of diaphragms 41 and 42 are adapted to be actuated by an electromagnet or a plurality of electromagnets hidden within the frame of a pair of eyeglasses. The electromagnets can be disposed within the rims 43 and 44 of the eyeglasses or within the nose bridge 46.

Fig. 7 illustrates one construction of the device when the rims of the eyeglasses are employed to house the electromagnets. Rims 43 and 44 of the eyeglasses can be molded about the electromagnets which preferably have a shape corresponding to that of the rims. For actuating diaphragm 41 I have shown an electromagnet provided with a core 47 of generally circular shape having enlarged ends 48 and 49 which constitute the pole pieces of the magnet and about core 47 a coil 51 is wound having a relatively large number of turns.

The electromagnet for vibrating diaphragm 42 is of similar construction and comprises a core 52 having poles 53 and 54 and about which is wound a coil 56. Preferably, coils 51 and 56 of the respective electromagnets are connected in parallel by conductors 57 and 58 extending through the nose bridge of the eyeglasses. By this construction the receiving, or vibrating, apparatus of the audiphone simulates the appear-

ance of a pair of ordinary eyeglasses. The weight of the device is relatively small and is well distributed, thereby eliminating the annoying discomfort of prior devices of this nature which usually are provided with a receiver which is adapted to be placed over or within the ear.

When it is desired to employ the nose bridge of a pair of eyeglasses for housing the electromagnetic means, the device can have a construction similar to that illustrated in Fig. 9. The core 59 of the electromagnet is approximately horse-shoe shaped and the poles 61 and 62 thereof can each be disposed adjacent one of the diaphragms 41 or 42. The coil 63 of the electromagnet can be embedded in the nose bridge when the same is made of moldable material, or if desired, the nose bridge can be made tubular and the electromagnet can be encased therein. Conductors 21 and 22 can be embedded or encased in one or both of the rims of the eyeglasses and extend to the microphone of the device as heretofore described.

It is to be understood that any suitable microphone or other pick-up device can be employed with the audiphone, and if desired, suitable amplifying means can be utilized for amplifying the sounds to be received.

The form of invention shown in Figs. 10, 11 and 12 illustrates another form of embodiment in which a vibrating member 64, having a thin diaphragm 65, is connected to a balanced armature or receiver unit 66 by means of a flexible tube 67 filled with a liquid, preferably of light weight. Light weight oil has been found to serve well. This liquid 68 is in direct contact with and is confined by the diaphragm 69 of the balanced armature unit 66. This diaphragm 69 is actuated by the electromagnet 70 and associated elements in the well known manner by means of electric energy supplied through conductors 71 and 72.

From the microphone 73 an electric conductor 74 extends to battery 75, and electric conductors 76 and 77 extend from the microphone and battery respectively to a radio amplifying unit comprising (a) the standard audiotransformer 78, (b) volume control 79, (c) the conductors 80 and 81, (d) the thermionic vacuum tube 82, (e) the usual A battery 83 and B battery 84, and (f) conductors 85 and 86 which connect with conductors 71 and 72. Obviously, the mode of operation of this circuit is through amplification, the sound waves impinging upon the microphone 73 and transmitting these impulses amplified in the usual manner of the radio circuits to the balanced armature receiver unit 66. This unit in turn transmits the radio amplified impulses to the diaphragm 69, and these in turn, with

its preferred large form of diameter, further amplifies the impulses and transmits the same through the fluid 68 of the flexible tube 67 to the vibrating member 65, which in turn is held against the bony structure of the head so that the impulses are thus in turn transmitted through the bony structure to the inner ear, or auditory nerve. The microphone, and amplifying means, if any, is or are defined for purposes herein, as the sound reproducing unit.

Instead of conductors 76 and 77 being connected to the audiotransformer 78, they may be connected directly to conductors 71 and 72. This alternate form of circuit connection is indicated in the dotted line 87 and 88. This form of circuit obviously omits the amplification incident to the radio or thermionic tube elements.

In Fig. 11 the flexible tube 67 leads to a vibrating member 89 carried by a bow of a spectacle frame, while in Fig. 12 a hollow rim 90 is illustrated, so that the liquid from the flexible tube 67 may communicate directly with the vibrating means 91.

In Fig. 13 a permanent magnet 92 terminates in soft permeable core members 93, the better to provide for electromagnetic windings 94. The windings of the electromagnets build up the cores to the diameter of the permanent magnets.

In Fig. 14 a standard type of microphone is shown having diaphragm 95 under cover 96, having openings 97, carbon receptacle 98 and conductors 99 and 100, which may connect with desired conductors.

In the modified form shown in Fig. 15 a permanent magnet 101 is provided with electromagnet members 102 and 103 to operate diaphragm 104.

It will be understood that the various forms of receivers or vibratory members may be interchangeably disposed in the spectacle frame.

It may be understood that, if the party using the device embodying my invention does not need regular glasses, then suitable plain glass may be embodied in the spectacle frame. The sound reproducing units and batteries may be disposed about the body in suitable pocket means.

Wherever it is stated herein that vibratory parts of the device embodying my invention contact the bones of the head, it will be understood that it is meant they contact the skin over said bones.

Obviously, changes may be made in the forms, dimensions, and arrangement of the parts of my invention within the scope of the claims, without departing from the principle thereof, the above setting forth only preferred forms of embodiment.

I claim:

1. In a device of the character described, the combination of a spectacle frame; a vi-

70

75

80

85

90

95

100

105

110

115

120

125

130

brating member carried by said spectacle frame and held directly against a bone portion of the head by said spectacle frame; electro-magnetic actuating means for said vibrating member carried by said spectacle frame; means affording a source of electrical energy; a microphone; and electrical conductor members connecting said microphone, said electro-magnetic actuating device and said means affording a source of electrical energy.

2. In a device of the class described, a spectacle frame; a diaphragm, carried by said spectacle frame, operating in a magnetic field, said diaphragm being operatively disposed to bear directly against a bone of the head; and actuating means for said diaphragm carried by said spectacle frame.

3. A spectacle frame embodying eye members having an electro magnet therein; a vibrating member operatively disposed with respect to said electro magnet, said vibrating member forming nose contacting members; and actuating means responsive to sound waves for said vibrating member.

4. In a device of the character described, a vibratory member adapted to abut against one of the bones of the user's head to transmit vibrations to the auditory organs, said vibratory member being mounted on the frame of a pair of eyeglasses, electromagnetic means for vibrating said member, electrical conductors for said electromagnetic means, said electromagnetic means and certain one of the conductors therefor being disposed within the frame of the eyeglasses, and a ribbon extending from the eyeglasses for covering other conductors.

5. In an audiphone of the character described, a frame adapted to be worn before the eyes, a vibratory member mounted on said frame and an electromagnet for vibrating said member, said electromagnet being disposed within said frame.

6. In an audiphone of the character described, a frame adapted to be worn before the eyes, a vibratory member mounted on said frame, said member adapted to abut against one of the bones of the wearer's head, and electromagnetic means for vibrating said member in accordance with sound waves, said electromagnet means being disposed within said frame.

7. In an audiphone of the character described, a frame adapted to be worn before the eyes, a vibratory member mounted on said frame adapted to abut against the wearer's nasal bone and electromagnetic means for vibrating said member, said electromagnetic means being secured to said frame.

8. In an audiphone of the character described, a frame adapted to be worn before the eyes, said frame having a pair of rims and a nose bridge, a vibratory member

mounted on said frame adapted to abut against the wearer's nasal bone and electromagnetic means for vibrating said member, said electromagnetic means being disposed within said nose bridge.

9. In an audiphone of the character described, a frame adapted to be worn before the eyes, said frame having a pair of rims and a nose bridge, a vibratory member mounted on said frame adapted to abut against the wearer's nasal bone, electromagnetic means for vibrating said member, said electromagnetic means being disposed on said nose bridge, and electrical conductors for said electromagnetic means, said conductors being encased within one of the rims of said frame.

10. In an audiphone of the character described, a frame adapted to be worn before the eyes, said frame having a pair of rims and a nose bridge, a vibratory member mounted on said frame adapted to abut against the wearer's nasal bone, electromagnetic means for vibrating said member, said electromagnet means being disposed within one of the rims of said frame.

11. In an audiphone of the character described, a frame adapted to be worn before the eyes of a wearer having bows extending to points behind the ears, a vibratory member adapted to abut against the wearer's mastoid temporal bone and electromagnetic means for vibrating said member, said electromagnetic means being mounted on one of the bows of said frame.

12. In an audiphone of the character described, a frame adapted to be worn before the eyes provided with rims and suitable for a pair of eye-glasses, a pair of vibratory members mounted on said frame, said members adapted to abut against the sides of the wearer's nasal bone, an electromagnet for vibrating each of said vibratory members, each of said electromagnets being mounted in one of the rims of said frame.

In witness whereof, I hereunto subscribe my name this 21st day of January, 1931.

WILLIAM G. G. BENWAY.