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T. B. FORDHAM ET AL

2,409,481

COMBINED HEARING AID AND RADIO RECEIVING SET

Filed June 26, 1941

2 Sheets-Sheet 1

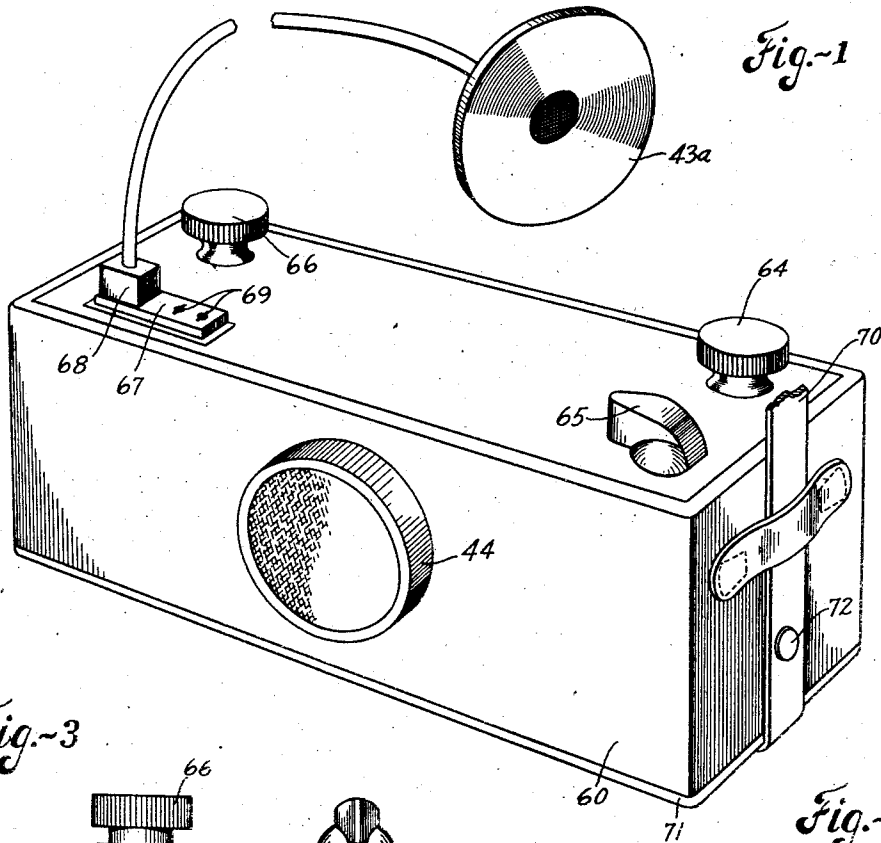


Fig. 3

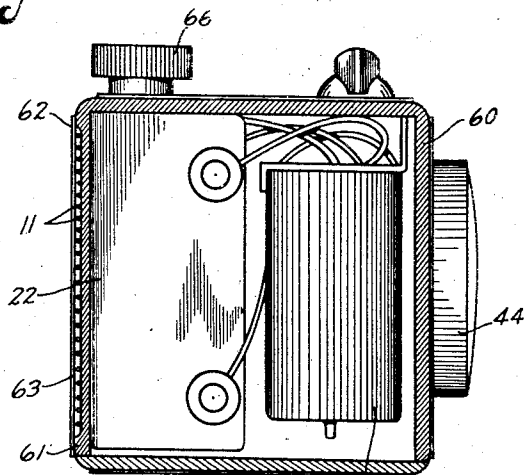
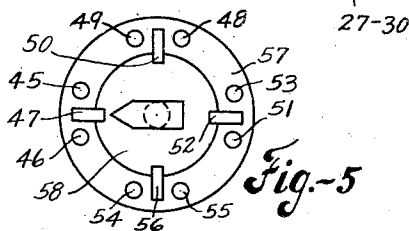
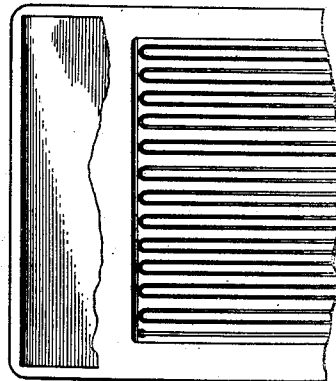


Fig. 4



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2 Sheets-Sheet 2

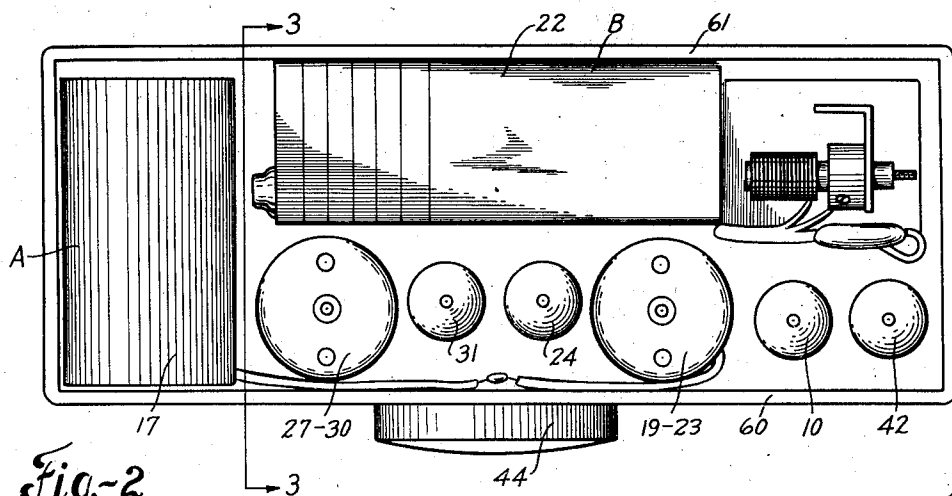


Fig.-2

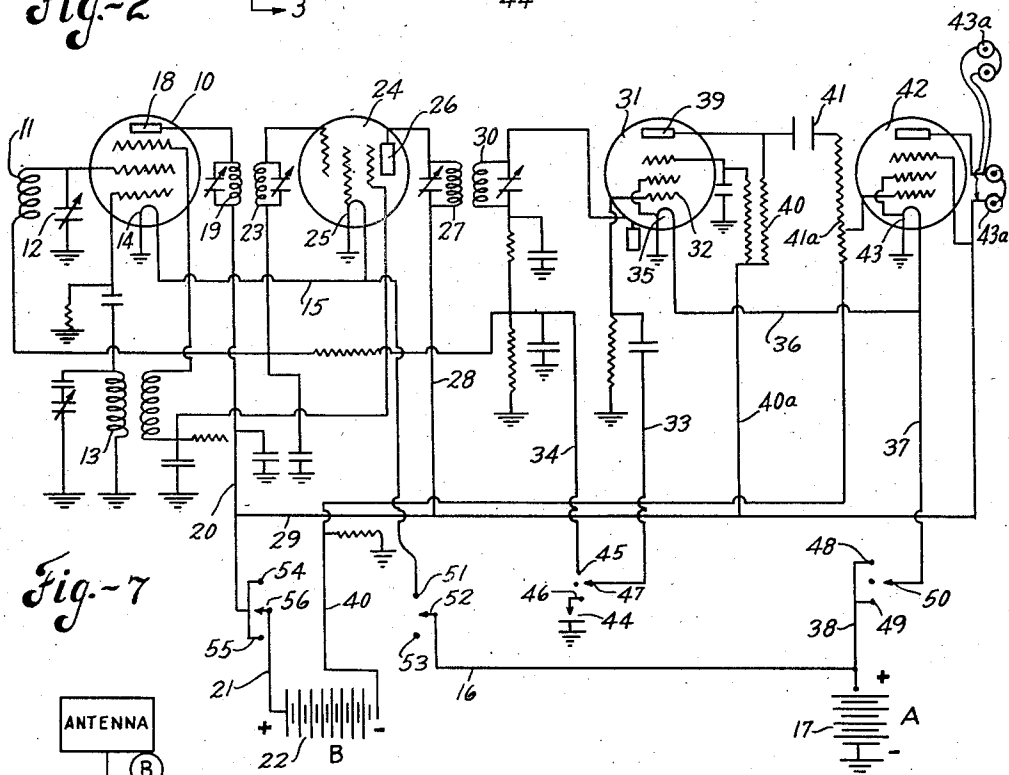


Fig.-7

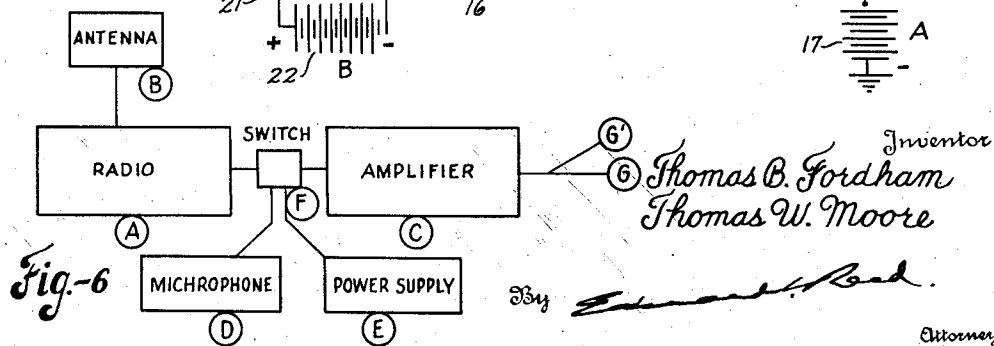


Fig.-6

UNITED STATES PATENT OFFICE

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COMBINED HEARING AID AND RADIO
RECEIVING SETThomas B. Fordham and Thomas W. Moore,
Dayton, Ohio

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This invention relates to a combined hearing aid and radio receiving set and one object of the invention is to provide such an apparatus which will be self-contained, highly efficient in operation and of a small compact character which will enable it to be easily carried by the user.

A further object of the invention is to provide an apparatus of such a character that a superheterodyne radio receiving set may be utilized therein, the latter being susceptible of a very compact arrangement without impairing its efficiency.

A further object of the invention is to provide such an apparatus with a loop antenna built into the apparatus and so arranged that it will not appreciably increase the size of the apparatus and its efficiency will not be impaired by other parts of the apparatus.

A further object of the invention is to provide such an apparatus in which the circuit changes necessary to connect the final audio frequency amplifier, and the head phones, with either the microphone or the radio receiving set can be effected by a single control switch, which will also cut out of circuit the heaters of those tubes which are not in use when the microphone is connected with said amplifier.

A further object of the invention is to provide such an apparatus which will enable two persons who are hard of hearing to converse one with the other.

Other objects of the invention may appear as the apparatus is described in detail.

In the accompanying drawings Fig. 1 is a perspective view of an apparatus embodying my invention, with the carrying strap broken away; Fig. 2 is a bottom plan view of such an apparatus with the bottom closure removed; Fig. 3 is a transverse section taken on the line 3-3 of Fig. 2; Fig. 4 is an elevation of the rear wall of the case showing the antenna mounted therein; Fig. 5 is a schematic view of the control switch; Fig. 6 is a block diagram of the apparatus; and Fig. 7 is a circuit diagram.

In these drawings we have illustrated a form of the apparatus which has given good results in use but it will be understood that the apparatus may take various forms without departing from the spirit of the invention.

As shown in Fig. 6 the apparatus comprises a superheterodyne radio receiving set A, built-in loop antenna B, an audio frequency amplifier C, a microphone D, a power supply E, a control switch F for connecting either the receiving set or the microphone with the audio amplifier and for con-

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trolling the connections between the power supply and the various units of the apparatus, and a head phone or phones G and G'.

We prefer to use a superheterodyne radio receiving set because it is of such a character as to lend itself readily to the very compact arrangement which is essential in an apparatus of this kind. The circuit is shown in substantially all of its detail but inasmuch as this circuit is of a well known character it is unnecessary to describe the same in detail and the description will be limited to those elements which enter more particularly into the combinations which effect the desired results. As here shown, the receiving set comprises an oscillator-mixer tube 10 the grid of which is connected with an antenna coil 11, a tuning condenser 12 being used to tune the antenna circuit to resonance. The oscillator coils are shown at 13. The cathode or filament 14 of the oscillator-mixer is connected by conduits 15 and 16 with the A battery 17. The plate 18 of the oscillator-mixer is connected with the primary 19 of a first intermediate frequency transformer, which is connected by conductors 20 and 21 with the positive side of the B battery 22. The secondary 23 of the transformer is connected with an intermediate frequency amplifier tube 24, the cathode 25 of which is connected with the conductor 15 leading to the A-battery 17. The plate 26 of the amplifier 24 is connected with the primary 27 of a second intermediate frequency transformer which is connected by conductors 28 and 29 with the conductor 20 leading to the B battery 22. The secondary 30 of the second transformer is connected with a combined tube 31 which functions as a detector, an automatic volume control and a first audio frequency amplifier. The rectified voltage developed across the resistor in series with the secondary of the second transformer energizes the grid 32 of the tube 31 through conductors 33 and 34. The cathode 35 of the combined tube is connected by conductors 36, 37 and 38 with the A battery 17. The plate 39 of the combined tube 31 is connected through its plate resistor 40 and conductor 40a with the conductor 29 leading to the positive side of the B battery 22 and is connected through a blocking condenser 41 to a potentiometer 41a and a final audio frequency amplifier tube 42, the cathode 43 of which is connected with the A battery 17 by conductors 37 and 38. The head phones 43a are connected in the output circuit of the amplifier 42. The final audio frequency amplifier 42 is not an essential part of the super-

heterodyne radio receiving set but is used only when additional audio amplification is desired.

Means are provided for disconnecting the audio frequency amplifying unit from the radio receiving set and for connecting the same with a microphone 44, so as to enable the apparatus to be used either as a radio receiving set or as a hearing aid. In the present arrangement the microphone connection is interposed between the conductor 33 and ground through a control switch. The control means may take various forms but is here shown as switch means comprising a stationary contact 45 connected with the conductor 34, a stationary contact 46 connected with the microphone circuit and a movable contact 47 arranged normally in an intermediate position to disconnect the audio frequency amplifier from both the radio circuit and the microphone circuit. When the movable contact is moved into engagement with the stationary contact 45 the radio circuit is connected to the audio frequency amplifier and when the movable contact engages the stationary contact 46 the radio circuit is interrupted and the microphone is connected in circuit with the audio frequency amplifier. Means are also provided for disconnecting the batteries, or power source, from the respective elements of the circuit when the apparatus is not in use and these means are preferably so combined with the microphone switch 44-47 as to be operated simultaneously therewith. In the arrangement shown the connections between the A battery and the cathodes for the tubes 31 and 42 are controlled by switch means including stationary contacts 49 and 49 connected with a conductor 38 which in turn is connected with the positive side of the A battery and a movable contact 50 connected with the conductor 37 and arranged normally in an intermediate position to interrupt the circuit but adapted to close the circuit when moved in either direction from its normal position. The circuit connections between the cathodes for the tubes 18 and 24 and the A battery are controlled by switch means including a stationary contact 51 connected with the conductor 15 and a movable contact 52 connected with the conductor 16 and movable from its normal or intermediate position into engagement with the stationary contact 15 to close the circuit through the cathode. The contact 52 is movable in either direction from its normal position but the contact 53 is a dead contact which merely indicates the position to which the movable contact is moved when the microphone is connected to the audio frequency transformer. The connections between the positive side of the B battery 22 and the several elements energized thereby comprise two stationary contacts 54 and 55 connected with the conductor 20 and a movable contact 56 connected with the conductor 21 and the battery. When this movable contact is in its normal intermediate position the positive side of the battery is disconnected from all elements and when the movable contact engages either of the stationary contacts 54 or 55 the circuit is closed through those elements. The several switch means may be connected for simultaneous operation in any suitable manner and in Fig. 5 we have illustrated schematically a type of a switch which may be used for simultaneously controlling all the above described switch elements. As there shown, the switch comprises a base plate 57 on which the four pairs of stationary contacts are mounted and from which the contacts are insulated. A mov-

able member 58 is rotatably mounted on the base 57 and carries the four movable contacts, which are shown in the form of fingers and are arranged normally between the stationary contacts of the respective pairs so that when the rotatable member is moved in one direction from its normal position the several circuits necessary to the operation of the radio receiving set will be closed and when moved in the other direction from its normal position the microphone will be connected with the final audio frequency amplifier, the B battery circuit will be closed, the A battery circuit will be closed through the cathodes of tubes 31 and 42 and the A battery circuit through the cathodes of tubes 10 and 24 will be opened, thereby conserving both the battery current and the tubes.

The several elements of the apparatus, excepting the head phone, are assembled in a small compact case which can be easily carried by the person using the apparatus. In the form now used the case is of rectangular construction and is of an overall length of approximately eight inches and of a width of two inches and of a depth of two inches. The microphone 44 is mounted in one wall, 60, of the case, which may be designated as the front wall, and the antenna is carried by the opposite or rear wall 61 of the case. This rear wall, and in the present instance the entire case, is formed of suitable insulating material, preferably of a character which is little affected by moisture, such as a phenolic material. The antenna is preferably set into the outer surface of the wall so as not to project beyond the latter. In the present instance the wall is shown as provided with a recess 62 in which the antenna coil is arranged. In practice, however, we prefer to soften the outer surface of the back wall, as by the application of a solvent thereto, and to press the windings of the antenna coil into the softened material so as to firmly embed the same therein. The antenna is then enclosed by an outer covering 63 of sheet material which extends about the case.

The audion tubes, and the transformers which are enclosed in metal shells, are arranged in a line along the front wall of the case and the B battery 22 is arranged between the back wall 61 and the tubes and transformers. In this manner the antenna is spaced from the major metal parts of the apparatus in such a manner that it will be little affected thereby. The A battery 17 is arranged in the left hand end of the case, as shown in Figs. 1 and 2, and preferably in the lower portion thereof when the case is in its upright position, which is the upper portion when the case is inverted as shown in Fig. 2. Arranged in the other end of the case is the tuning condenser, which is operated by a knob 54 on the top of the case, the control switch 57-58, which is actuated by a finger piece 65 on the top of the case, and the oscillator coils of the oscillator-mixer tube 10. A volume control is also arranged, preferably, in the left hand end of the case above the A battery and is adjusted by a knob 66 on the top of the case. Also arranged in the top of the case is a socket element 67 adapted to receive a connector 68 whereby the head phone is connected in circuit with the final audio frequency amplifier. This head phone is shown as a simple hand supported disk-like element but it will be understood that it may be of any suitable character and that a bone conduction unit, ear plug or a loud speaker may be substituted therefor. The socket 67 is in the pres-

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ent instance provided with a plurality of sockets, one pair of which is shown at 69, to permit a plurality of head phones to be connected therewith and thus enable two deaf persons to converse one with the other by the use of a single apparatus.

Any suitable means may be provided for carrying the apparatus but preferably a shoulder strap 70 is provided for this purpose. The bottom closure 71 may be removably secured to the case in any desired manner but as here shown it is secured in place by the shoulder strap, the end portions of which extend downwardly across the ends of the case and beneath the bottom closure, to which they may be rigidly secured in any suitable manner. Suitable means, such as snap fasteners 72, are provided for detachably securing the ends of the shoulder strap to the ends of the case at points adjacent the bottom closure so as to firmly support the latter thereon. Thus the shoulder strap itself will serve to retain the closure in its proper position and will prevent the displacement of the same while the apparatus is being carried by the user.

While we have shown and described one embodiment of our invention we wish it to be understood that we do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art.

Having now fully described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. In a self-contained portable apparatus of the type including a case, a radio receiving set, a final audio frequency amplifier and a source of electrical energy all mounted in said case; an antenna built into said case, a microphone mounted on a wall of said case, and operable means for connecting said amplifier with either said radio receiving set or said microphone and for disconnecting said source of energy from the cathodes of those tubes which are used only in radio reception simultaneously with the connecting of said amplifier with said microphone.

2. In a self-contained portable apparatus of the type including a case in which are mounted a radio receiving set, an audio frequency amplifier and a source of electrical energy connected with said receiving set and said amplifier; an antenna carried by a wall of said case in fixed relation to the elements in said case and connected with said receiving set, a microphone carried by the wall of said case, and means including a single actuating device operable from the exterior of said case for separately connecting either said microphone or said receiving set with said amplifier and for disconnecting those elements which are used only in radio reception from said source of energy when said amplifier is connected with said microphone.

3. In a self-contained portable apparatus of the type including a radio receiving set, an audio frequency amplifier connected with said receiving set, and A and B batteries for energizing said receiving set and said amplifier; an antenna carried by a wall of said case, a microphone mounted on said case, and operable means for disconnecting said audio frequency amplifier from said receiving set and for connecting the same with said microphone and for disconnecting said

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A battery from those elements of said receiving set which are used only in radio reception.

4. In a self-contained portable apparatus of the type comprising a case in which are mounted a radio receiving set including an oscillator-mixer tube, an intermediate frequency amplifier tube, a combined first audio frequency amplifier, automatic volume control and detector tube and a final audio frequency tube, an A battery to supply current to the cathodes of said tubes, a B battery to supply current to the plates of said tubes, an antenna and a microphone carried by said case, and a single switch for connecting the audio frequency amplifier circuits with either said microphone or said receiving set and for disconnecting said A battery from the cathodes of said oscillator-mixer and said intermediate frequency amplifier when said microphone is connected with said audio frequency amplifier circuit.

5. In a self-contained portable apparatus of the type including a case, a radio set, a final audio frequency amplifier and a source of electrical energy all mounted within said case; an antenna built into a fixed wall of said case, a microphone mounted on a wall of said case and operable means for connecting said amplifier with said radio receiving set or said microphone.

6. In a self-contained portable apparatus of the type including the case in which there are mounted a radio receiving set and an audio frequency amplifier including "audion" tubes and transformers, a loop antenna carried by a fixed wall of said case in spaced relation to said tubes and said transformers, means interposed between said antenna and said tubes and transformers to prevent material interference between the same, a microphone carried by said case and means operable from the exterior of said case for separately connecting either said microphone or said receiving set with said audio frequency amplifier.

7. In a self-contained portable apparatus of the character described, an elongate case, a radio receiving set, and an audio frequency amplifier within said case and including "audion" tubes and transformers arranged along one longitudinal wall of said case, a battery arranged between the opposed longitudinal wall of said case and said tubes and transformers, a loop antenna rigidly secured to the last mentioned longitudinal wall, a microphone carried by said case, and means for connecting either said microphone or said receiving set with said audio frequency amplifier.

8. In a self-contained portable apparatus of the character described, a case having laterally spaced opposed walls insulated one from the other, a radio receiving set and an audio frequency amplifier within said case and including "audion" tubes and transformers arranged adjacent one of said opposed walls, and an antenna comprising a substantially flat coil embedded in the other of said opposed walls, a microphone carried by a wall of said case and means operable from the exterior of said case for connecting said microphone with either said receiving set or said amplifier with said audio frequency amplifier.

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