PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improved Method of and Apparatus for the Transmission of Speech and other Sounds

We, JOSEPH POLIAKOFF, of 92, New Cavendish Street, London, W.1, of Russian nationality, and OSWALD BARBER SNEATH, of 22, Sunny Gardens, Hendon, London, N.W.4, a British subject, do hereby declare the nature of this invention to be as follows:—

The invention relates to a method of transmitting speech or other sounds to be received by means of small portable instruments, within a limited space such as the auditorium of a cinema or theatre, or a sports arena, and is suitable for assisting people who are deaf or are hard of hearing to follow the programme through headphones or bone conductors. It has the advantage over the system of deaf aid commonly employed in cinemas that the deaf person can take a small portable instrument to any seat and does not have to plug it into one of a number of fixed points. The method is moreover applicable for occasions where the user is free to move about.

According to this invention a magnetic field varying in accordance with speech or other sounds is established within a limited space and has the intensity thereof controlled by a thermionic or other amplification apparatus, and a receiving apparatus such for example, as a deaf-aid apparatus, is located within the said magnetic field and is adapted to receive by means of a coil without interference from sound waves in the said space the speech or other sounds transmitted by the said amplification apparatus.

The programme is transmitted by connecting the output from a sound amplification apparatus preferably through a suitable transformer to a coil which may consist of one or more turns of wire extending for example round the wall, or along or under the floor of a theatre, or along or over the ceiling of, and enclosing the whole or a large part of, the auditorium, restaurant or other parts of a building, the said coil serving as a transmitting coil which produces the magnetic field above mentioned, the intensity of which is under the control of the amplification apparatus. In order to give as uniform a response as possible over the whole auditorium one or more turns should be near floor level and one or more turns near the ceiling.

The receiving apparatus includes a coil to react with the varying magnetic field, such receiving apparatus may also include the normal microphone, and if both are incorporated in the receiving apparatus either a two-way switch is provided or else the coil is adapted to be plugged-in when required, the microphone being then rendered inoperative in any convenient manner.

The receiving apparatus may be adapted for use by deaf persons to act as a normal deaf aid amplifier of sound simultaneously with the receiving and reproduction of the programme electrically transmitted by the amplification apparatus. If desired however, it may be provided with a switch to permit its use for one purpose or the other. Furthermore a loud speaker may also be operated by the receiving apparatus.

The receiving apparatus may each consist of a multi-valve amplifier, a three valve amplifier being found sufficient under normal conditions. The receiving coil is connected directly, or through a transformer to the grid of the first valve. The receiving coil may be several inches across and may be of circular, square or other suitable form and where no transformer is employed the said winding or coil may have about 12,000 turns. If the resistance of the transmitting coil is greater than the inductive impedance over the material range of frequencies, then the current in the transmitting coil will be substantially independent of frequency and the voltage generated across the receiving coil for a given signal strength will be approximately proportional to frequency. This effect is corrected by connecting across the receiving winding or coil or across the secondary of its associated transformer, a resistance which is less than the impedance of the receiving winding or coil or its reflected inductive impedance across the transformer secondary respectively over the material range of frequencies. The receiving coil may in some cases be provided with an iron core and be of cylindrical form, e.g. like a pencil.

As an example, it may be found satisfactory if the response is reasonably uniform between 300 and 3,000 cycles. To ensure this the impedance of the transmitting coil at 3,000 cycles must be primarily resistive and not inductive. The resistance of the receiving coil or the reflected resistance across the secondary of the transformer at 300 cycles must be primarily inductive and be shunted by a fixed resistance at least not greater than this impedance, and the impedance of this coil at 3,000 cycles which in the case of a coil of a great number of turns will be largely dependent on its self capacity, must be not greater than the shunting resistance.

Where the ohmic resistance of the coil may be considerable compared with the inductive impedance of the coil at some frequencies within range for which a linear response is required, instead of shunting the coil by a resistance alone it should be shunted by a resistance and a condenser in series with one another, the value of the resistance being determined in the same manner as previously and the condenser being of such value that its impedance bears the same ratio to the shunting resistance as the ohmic resistance of the coil does to the inductive impedance of the coil.

If the ohmic resistance of the coil is considerable compared with its inductive impedance over the entire frequency range concerned, then it should be shunted with a condenser alone of such value that its impedance is low compared with the resistance of the coil over the frequency range in question.

It may be found desirable in some cases to increase the effective resistance of coil by winding it with resistance wire or by connecting a resistance in series.

Volume and tone control may be obtained by varying the resistance and/or the condenser shunting said coil and/or the resistance in series with the coil, and/or by varying the inductance of the coil by means of tapping or any other known method.

The coil may also serve for tone control purposes when the apparatus is used as a normal deaf-aid apparatus as for instance by connecting it in parallel across a capacity microphone.

As the skin effect in the transmitting coil tends to cause the resistance to rise with the frequency, means should be adopted to minimise this skin effect. This can be done by using a cable formed of a large number of insulated plaited strands and where necessary loading it with a resistance in series, which may be variable for volume control. Furthermore volume compression or expansion may be effected by arranging in series with the transmitting coil a resistance whose impedance decreases or increases with current, e.g. a carbon or a metal filament electric lamp.

As an alternative method the transmitting coil may be made primarily inductive by employing very heavy wire and if necessary loading it with a series inductance. In this case the current in the transmitting coil will vary inversely to the frequency and correction need not than be made in the receiving apparatus. In this later case, however, the number of turns in the receiving coil cannot be as high as formerly, since the impedance due to the inductance of the receiving coil must be considerable compared with its self-capacity at the higher material frequencies. If the transmitting coil is in a horizontal plane as described, the receiving coil must also be horizontal but if the transmitting coil is in a vertical plane, the receiving coil must be maintained in a parallel vertical plane, a condition that may be inconvenient where members of the audience are moving about, although in some other cases it may be preferable.

Where it is required to cover a fairly large area, instead of employing a single coil around the area there can be substituted a cable led backwards and forwards across the area in approximately parallel paths so that the current in adjacent parallel lengths is flowing in opposite directions. If the pick-up coil is horizontal and exactly over one of the wires, it will fail to receive signals but a slight displacement or tilt about an axis parallel to the wire will restore it to action.

Where the wire is laid close to the ground or on a conducting or partially conducting medium, it will reduce the efficiency and will also to some extent affect the relative frequency response, as the loss will be greatest at high frequencies. The frequency correction may require to be modified to meet the particular conditions or may even be dispensed with in some cases.

Dated this 3rd day of July, 1937.

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Agents for the Applicants.

COMPLETE SPECIFICATION

Improved Method of and Apparatus for the Transmission of Speech and other Sounds

We, JOSEPH POLIAKOFF, of 92, New Cavendish Street, London, W.1, of Russian nationality, and OSWALD BARBER SNEATH, of 22, Sunny Gardens, Hendon, London, N.W.4, a British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to a method of transmitting speech and other sounds, including recorded speech and sounds, within a limited space such as the auditorium of a cinema or theatre, or a sports arena; and to transmitting apparatus and receiving apparatus for carrying the method into practice. The invention is particularly intended for assisting people who are deaf or hard of hearing to receive speech and other sounds through headphones or bone conductors by the aid of a portable apparatus. It has thus the advantage over the systems of deaf aid commonly installed in cinemas and theatres, that the deaf person can hear with a small portable instrument or receiving apparatus from any seat or can move about and does not have to plug it into one of a number of fixed points.

Electro magnetic induction has been suggested hitherto for distant communication, such as disclosed in Specification No. 29505/97, as well as for communication between a moving vehicle and a stationary point as described for example in Specification No. 16419/10. The present invention however, relates to transmission of speech and music from a stationary amplifier to portable thermionic valve receivers situated within a limited space, such reception being at a high sound intensity level and free from undesirable frequency distortion.

According to this invention the transmission takes place by audio-frequency induction between a conductor carrying an undulatory current and a pick-up coil energising a portable receiver. The transmitting apparatus comprises a power amplifier such as is commonly used for public address and allied purposes, the output of which is delivered to a single length or network of conductors disposed about the hall or auditorium. The limited space within which the transmitted signals can be efficiently received lies within and around the coil formed by the transmitting conductor or it may be restricted to a region adjacent to the said conductor when the size of the coil or loop is very large. The receiving apparatus comprises a thermionic amplifier having combined therewith a relatively small pick-up or receiving coil which may be connected by suitable flexible leads to the apparatus, and in the case where the amplifier is a deaf aid appliance having a microphone, may be arranged so that it can be switched in to replace the microphone or it can be effective simultaneously with the microphone.

The invention is illustrated by way of example in the accompanying drawings in which:

Figure 1 shows diagrammatically one form of transmitting apparatus according to this invention,

Figures 2 to 5 show modified arrangements of the transmitting conductor.

Figure 6 shows diagrammatically one form of receiving apparatus, and

Figures 7 to 9 show modifications of the receiving apparatus.

The output from a thermionic amplifier 1 is connected to a transmitting conductor 4 that forms loops 5, 6 which enclose areas that are approximately equal although not necessarily of similar shape. Such loops may for example, be arranged in the balcony of the cinema and have the current flowing therein in opposite directions. Thus the direction of flow of the current in the loop 5 is clockwise whilst in the loop 6 it is counterclockwise, whereby a substantial neutralisation of the fields of the two loops beyond a desired distance, i.e. outside the cinema, is obtained. Loops 7, 8, 9 and 10 in series with the loops 5 and 6, are arranged in another part of the cinema, for example the ground floor. The transmitting conductor is preferably earthed as shown at 11 to prevent the said conductor from having a potential to earth other than that due to the small A.C. potential across the output terminals of the amplifier. Moreover, the parts of the transmitting conductor that form leads between the amplifier and the loops and between the several groups of loops, should be kept parallel to one another and close together so as not to produce a substantial field in themselves, such leads being, if desired, arranged in conduits in a manner similar to mains wiring. The amount of power necessary for the satisfactory working will, where there is no outside electrical interference, be determined by the amplification of the receiving apparatus, but it will in practice frequently depend upon the power needed to mask interference by other electrical apparatus.

Figure 2 shows a modified arrangement of the loops of a transmitting conductor in which loops 12—19 are in series. The loops 12, 14, 16 and 18 have the current flowing therein in a clockwise direction whilst in the loops 13, 15, 17 and 19 the current flows counterclockwise. The area enclosed by the loops 12, 14, 16, and 18 is made substantially equal to the area enclosed by the loops 13, 15, 17 and 19, for the reason above set forth.

In some cases however the loops, or series of loops forming the transmitting conductor, are arranged in parallel. In this case, to obtain neutralisation at a distance, the aggregate of the products of the currents flowing clockwise by the areas enclosed by the loops conducting such currents, must equal the aggregate of the products of the currents flowing counterclockwise by the areas enclosed by the loops conducting such currents.

Figure 3 also shows an arrangement of transmitting conductor in which the areas enclosed by loops which are in series and in which the current flows respectively in clockwise and counterclockwise directions are substantially equal. In this case the transmitting conductor is formed into a large loop 20, in which the direction of flow is clockwise, and loops 21, 22, 23 and 24 in which the direction of flow is counterclockwise, all of the said loops 20 to 24 being in series. Furthermore, the loops are so disposed that the median point or centre 25 of the loop 20 coincides with the median point or common centre about which the loops 21 to 24 are arranged.

Figures 4 and 5 show further arrangements of transmitting conductors in the form of loops, arranged in series and presenting the same features as those disclosed in Figure 3. By thus having the loops arranged about a common median point or centre, the neutralisation of the effects at a distance of the loops is obtained to a further degree than is possible if the series of loops are disposed for example as shown at 7—10 in Figure 1 in which the centre of the field formed by the loops 7 and 8 does not coincide with the centre of the field formed by the loops 9 and 10.

As shown in Figure 4, the conductor forms four loops 4*a*, 4*b*, 4*c* and 4*d* of which the intermediate loops 4*b*, 4*c* have current flowing in the same direction. Thus the field produced between them will be weak and they should be placed close to each other. This arrangement is particularly advantageous where reception is more particularly required at the outer part of an enclosed area as is the case with sports arenas, e.g. a football ground, where the central part of the enclosed space is occupied by the players.

As shown in Figure 6 a receiving apparatus suitable for deaf aid purposes may comprise a thermionic amplifier having three thermionic valves 26, 27 and 28. In the input circuit of the grid of the thermionic valve 26 is a pick-up coil 29 which is screened against electro-static reaction and interference by metallic discs 30, 31. The said screening discs, unless of low conductivity, should be perforated or slotted to reduce induced currents. A potentiometer 32 is used for volume control. It is generally desirable to apply a slight bias to the grid of the valve 26 to which the pick-up coil is connected, as otherwise the grid current may cause the impedance of the pick-up circuit to drop sufficiently to alter adversely the frequency response curve of the amplifier. Bias for the first and second stages of amplification is obtained by the voltage drop across an electric flash lamp 34 arranged in the cathode circuit and bias for the output valve 28 is obtained by superimposing on the voltage drop across the electric flash lamp 34, a voltage drop across a resistance 35 which is shunted by a condenser 36. A headphone 37 is arranged in the anode circuit of the thermionic valve 28. With a receiving apparatus as shown, it has been found that decoupling of the high tension current for the thermionic valve 27 is unnecessary.

Instead of applying bias as set forth above, the grid of the valve 26 may be made self biasing by incorporating in the grid circuit a condenser 62 shunted by a high resistance 63, in which case the electric lamp 34 may in some circumstances be dispensed with.

Figure 7 shows diagrammatically an arrangement of deaf aid appliance including a capacity microphone adapted for use as a receiving apparatus in conjunction with a transmitting apparatus as shown in any of the Figures 1 to 5. By means of a switch 38 a microphone 39 or a suitably screened pick-up coil 40 can be connected to the grid of a valve 37 as desired. The pick-up coil 40 is shunted by a resistance 41, whilst the said coil and resistance are in series with a condenser 42. With this arrangement the receiving apparatus can be employed for receiving the signals transmitted through a transmitting conductor 4 by connecting the pick-up coil 40 to the grid of the thermionic valve 37, or it may be employed as a normal deaf aid appliance by connecting the microphone to the grid. It is preferable that the condenser 42 shall have a capacity sinilar to that of the microphone 39 so that when the pick-up coil is connected to the grid, the grid load may be substantially capacitative over all or a substantial part of the frequency range to be received, a condition that is desirable, for example, when negative reaction is applied to the grid for volume or tone control.

Figure 8 shows a further arrangement of receiving apparatus. A switch 44 is adapted to connect the primary winding of a step-up transformer 45 either to a carbon microphone 46 or to a pick-up coil 47 as desired. The secondary winding of the transformer 45 is connected to the grid of the thermionic valve 37 and also to the cathode of the valve through a condenser 48 that is shunted by a resistance 49 whereby bias is acquired by the grid of the valve 37. On account of low impedance of the coil in this case, the screening is generally unnecessary.

Figure 9 shows a modification of the receiving apparatus in which the microphone and the coil can act simultaneously in variable degrees controlled by a potentiometer 57 on the grid of a thermionic valve 51 respectively through resistances 52 and 53 and through resistances 55 and 56. The resistances 52 and 55 should be of such values that the loads of the microphone 50 and of the pick-up coil 54 are substantially resistive over the range of frequencies to be received whilst the resistances 53 and 56 should be of a like value and that of the potentiometer 57 somewhat higher. In order to obtain volume and tone control one or more of the resistances 52, 53, 55 and 56 may be made variable or shunted by a condenser to modify the tone. Thus for example, condensers 58 and 58^1 may be arranged to shunt respectively the resistances 53 and 56.

In order to obtain the most efficient reception it is usually preferable that the pick-up coil shall be parallel to the plane or planes of adjacent loops forming the transmitting conductor but in some cases, as when the receiving apparatus is situated immediately above or below the conductor, reception is very poor or negligible until the pick-up coil is tilted out of parallelism to the plane or planes of the said loops of the transmitting conductor.

Where wire of a light gauge is used for the transmitting conductor the ohmic resistance of the wire will be large compared with its inductance over the range or part of the range of frequencies to be received and the current flowing in the coil will be substantially independent of frequency. Where the resistance of the transmitting conductor is insufficient in itself, a fixed or variable resistance may be connected in series to render the load resistive over the whole frequency range. Tone control may be effected by varying such resistance The use of such a resistive load is particularly applicable where no separate output stage is employed but the transmitting conductor is connected in parallel with a resistive load such as loudspeakers. A receiving apparatus as hereinafter described with amplification independent of frequency must be used in conjunction with such transmitter if a uniform frequency response is required. On the other hand when the transmitting conductor consists of a heavy cable or copper foil its inductive impedance will usually exceed the ohmic resistance thereof over the material range of frequencies. In this case for frequencies at which the inductive impedance of the transmitting conductor is greater than that of the impedance of the output circuit to which it is coupled, the current produced in the transmitting conductor by a given output voltage falls off with rising frequency and tends to become inversely proportional to frequency when the inductance is large compared with the impedance of the said output circuit and the receiving apparatus and pick-up coil may be arranged to have an amplification proportional to frequency. In this latter case, where as uniform a frequency response as possible is required, the output of the amplifier should be adjusted according to the impedance of the transmitting conductor at low frequencies, e.g. 100 cycles, although in this case a greater power output rating will be necessary to obtain adequate signal volume than where it can be matched at a higher frequency and the loss of bass ignored. In some cases it may be necessary to connect an inductance in series with the transmitting conductor to render the load impedance substantially inductive down to low frequencies. Where a transmitting conductor offering an inductive load is connected to an amplifier that also supplies loud speakers offering a resistive load, the transmitting conductor may be shunted with a resistance and connected in series with the speakers.

In cases where the output stage of the power amplifier feeding the transmitting conductor comprises one or more pentodes, it is desirable to shunt the output circuit with a resistance shown at 59, Figure 1, thus giving a reflected impedance of the same order as the optimum working impedance of the pentode, or an equivalent effect may be obtained by known methods of negative reaction between the plate or plates and grid or grids of the pentodes.

Where the installation is in a cinema and an independent amplifier or output stage is employed, the input to the amplifier or output stage may be taken from some point in the speech amplifiers of the talking film reproducing equipment. Thus for example, the input to a low gain amplifier feeding the transmitting conductor may be taken from the low impedance output to a monitor speaker of the talking film reproducing equipment.

It may sometimes be desirable to provide automatic volume compression. This may be done by connecting a metal filament lamp 60, whose resistance rises considerably with temperature, in series with the transmitting conductor. Under normal circumstances the current in the transmitting conductor should be sufficient to bring the filament of the lamp 60 intermittently to red heat and its resistance at such a temperature should be of the order of that of the impedance of the transmitting conductor at middle speech frequencies. The effect of the variable resistance will be greatest at the low frequencies for which the impedance of the transmitting conductor is lowest; and this effect may be advantageous as it reduces masking at high sound volumes. Alternatively or additionally any known method of automatic volume control can be applied to the amplifier or its input.

Where the system is installed in a theatre it is usually desirable to employ an amplifier with a high degree of automatic volume control obtained in any known way and with its input coupled to several microphones in different positions on or near the stage.

At distances outside the loops of the transmitting conductor equal to a few times the diameter or width of the said loops, the induced field will be in most cases weaker than the electrical interference due to power cables which usually exist in towns.

The inductive field will not in general interfere with radio-receiving apparatus or telephones even if they are situated within the loop, the spread of the field may however be reduced by arranging the transmitting circuit to consist of one or more loops with the current flowing clockwise and one or more loops enclosing substantially an equal total area in which the current flows counterclockwise as shown in Figures 1 to 5.

Where the current in the transmitting conductor is substantially independent of frequency and a uniform response is required, the voltage set up across the pick-up coil is also made independent of frequency. To do this a resistance 33, Figure 6, is connected across the pick-up coil or the secondary of a transformer whose primary is connected to a pick-up coil, such resistance having a value which is less than the impedance of the pick-up coil or its reflected inductive impedance across the transformer secondary respectively, over the material range of frequencies. The pick-up coil may in some cases be provided with an iron core and be of cylindrical form.

To ensure a reasonably uniform response between 300 and 3,000 cycles, for example, the impedance of the transmitting conductor up to 3,000 cycles must be primarily resistive and not inductive. The impedance of the pick-up coil or the reflected impedance across the secondary of the transformer at 300 cycles must be primarily inductive and be shunted by a fixed resistance at least not greater than this impedance, and the impedance of this coil at 3,000 cycles, which in the case of a coil of a great number of turns may be largely dependent on its self-capacity, must be not less than the shunting resistance.

Where the ohmic resistance of the pick-up coil may be considerable compared with the inductive impedance thereof at some frequencies within a range for which a linear response is required, instead of shunting the coil by a resistance alone it should be shunted by a resistance and a condenser connected in series with one another. Thus a condenser 61 can be connected in series with the resistance 33, Figure 6, the value of the resistance being determined in the same manner as previously and the condenser being of such value that its impedance bears the same ratio to the shunting resistance as the ohmic resistance of the coil does to the inductive impedance of the coil.

If the ohmic resistance of the pick-up coil is considerable compared with its inductive impedance over the entire frequency range concerned, then it should be shunted with a condenser alone of such value that its impedance over the material frequency range is low compared with the resistance of the coil.

It may be found desirable in some cases to increase the effective resistance of the pick-up coil by winding it with resistance wire or by connecting a resistance in series.

Volume and tone control may be obtained by varying the resistance and/or the condenser shunting said coil and/or the resistance in series with the coil, and/or by varying the inductance of the coil by means of tapping or any other known method. Alternatively deviations from linear response may be corrected by any known method of tone correction in the transmitter or receiver irrespective of where they arise.

Where the intensity of current in the transmitting conductor falls with frequency a receiving apparatus whose pick-up rises with frequency should be employed. As in most cases of nerve deafness and in the case of normal hearing at high volumes a rising response curve is advantageous. A receiving apparatus having this characteristic may sometimes be used with advantage even where the current in the transmitting conductor is substantially independent of frequency.

Such a receiving apparatus may consist of a pick-up coil, whose natural resonance is above the range of speech frequency efficiently reproduced by headphones, coupled to the input of a thermionic amplifier. The sensitivity of the receiving apparatus will increase with the size of the pick-up coil and the number of turns therein, but increasing the size of or number of turns in the coil, in general lowers the frequency of its natural resonance due to its inductance and self capacity.

For maximum sensitivity the pick-up coil is wound so as to have its natural resonance near the top limit of the frequency range over which a fairly uniform response is required and the coil is shunted by a resistance. This resistance should, at the resonance frequency, be approximately equal to the impedance of a pure inductance whose inductance equals that of the pick-up coil.

The presence of the shunt resistance not only improves the frequency response but greatly reduces any tendency to instability on the part of the receiving apparatus.

Radio receiving apparatus, modified by incorporating therein or connecting thereto a suitable pick-up coil connected for example to the gramophone pick-up terminals of the apparatus, can be employed to receive the signals transmitted. In the case of a mains set the pick-up coil should however be located at a short distance away from the radio receiving apparatus to reduce interference picked up from the mains transformer or smoothing choke of the set. In this case the coil may be of larger dimensions than where it is employed with a deaf aid portable apparatus and may be mounted so that it can be turned to obtain maximum pick-up of speech or other sound with minimum pick-up of interference. It may conveniently be of one or a few turns of heavy gauge wire and be coupled to the set through a suitable step-up transformer. In this case it will generally be found desirable to earth the primary.

A receiving apparatus according to this invention will also function in stray inductive fields such as exist in proximity to most electromagnetic reproducers such as loudspeakers and the usual communication telephones or their associated transformers.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of transmitting speech and music throughout a limited area, such as the auditorium of a cinema or theatre, or a sports arena, by means of electromagnetic induction between a transmitting system of one or more closed conducting loops enclosing a substantial part of such area, and portable receivers situated within such area, such receivers consisting of a pick-up coil, thermionic valve amplifier and a suitable sound reproducer.

2. A method as claimed in Claim 1, wherein the undulatory current in the transmitting conductor is provided by one or more microphones and an amplifier.

3. A method as claimed in Claim 1, wherein the current in the transmitting conductor is produced by connecting the said conductor with or without shunt either directly through a transformer in series or in parallel with a loudspeaker used for purposes of talking film reproduction or speech reinforcement.

4. A method as claimed in Claim 1, wherein the current in the transmitting conductor is obtained from a separate output stage or amplifier, the input of which is coupled to some stage of an amplifier used in conjunction with talking film reproduction or normal sound reinforcement.

5. A method as claimed in Claim 1, wherein over the range of frequencies where a substantially uniform response is required, the impedance of the transmitting conductor is primarily resistive.

6. A method as claimed in Claim 1, wherein over the range of frequencies where substantially uniform response is required, the impedance of the transmitting conductor is primarily inductive.

7. An apparatus for transmitting speech or other sounds according to the method claimed in Claim 1, wherein a transmitting conductor consisting of a series of loops arranged in the same plane or in different planes is coupled to the output of a thermionic amplifier.

8. A transmitting apparatus as claimed in Claim 7, wherein the transmitting conductor is arranged to form a plurality of loops that are in series and are disposed in the same or parallel planes, the area enclosed by the loop or series of loops in which the current flows in a clockwise direction being substantially equal to the area enclosed by the loop or series of loops in which the current flows in a counter-clockwise direction, whereby the intensity

of the field, at a distance is reduced.

9. A transmitting apparatus according to Claim 8, wherein the median point of the loop or series of loops in which the current flows in a clockwise direction coincides with the median point of the loop or series of loops in which the current flows in a counterclockwise direction.

10. A transmitting apparatus as claimed in any of Claims 7 to 9, wherein there is arranged in series with the transmitting conductor either directly or through a transformer a resistance such as an electric lamp, whose resistance rises considerably with current for the purpose of volume compression.

11. A modification of the transmitting apparatus as claimed in Claim 7, wherein loops or series of loops forming the transmitting conductor are arranged in parallel.

12. A receiving apparatus for receiving signals according to the method claimed in Claim 1, wherein the pick-up coil is arranged in a low frequency input stage of a thermionic amplifier.

13. A receiving apparatus as claimed in Claim 12, wherein a microphonic speech amplifying apparatus, which normally serves as a deaf aid appliance, has provision for plugging in a pick-up coil in place of or in addition to the microphone.

14. A receiving apparatus as claimed in Claim 13, wherein the pick-up coil is adapted to be switched in to replace the microphone of a microphone speech amplifying apparatus.

15. A receiving apparatus as claimed in Claim 13, wherein signals that are received by the microphone of a microphonic speech amplifying apparatus and the pick-up coil are simultaneously fed to an input stage or separate input stages of the amplifier.

16. A receiving apparatus according to Claim 12, having a response rising with frequency, wherein the pick-up coil has a natural resonance at or beyond the upper frequency of the range of frequencies where a rising response is required.

17. A receiving apparatus as claimed in Claim 12, wherein the pick-up coil is adapted to be plugged or switched in to the audio frequency amplifier of a wireless set.

18. A receiving apparatus according to Claim 12, wherein the pick-up coil is shunted by a resistance and/or condenser of such value or values as to give a substantially uniform frequency response.

19. A receiving apparatus according to Claim 12, wherein the pick-up coil has a natural resonance at a frequency near the upper limit of the frequencies over which a rising response is required and a resistance is shunted across the said coil of the order or value of the impedance at the resonance frequency of a pure inductance of the same inductance as that of the pick-up coil.

20. A receiving apparatus as claimed in Claim 12, wherein the pick-up coil is connected in series with the primary winding of a transformer whose secondary winding is arranged in an input stage of the receiving apparatus, a resistance and/or a condenser being connected across the secondary winding of the transformer or across a part of such winding.

21. A receiving apparatus as claimed in any of Claims 17, 19 or 20, wherein volume and/or tone control are obtained by varying the effective values of the resistance and/or the condenser.

22. A receiving apparatus as claimed in any of Claims 12 to 21, wherein the pick-up coil is screened against electro-static reaction and interference.

23. A transmitting apparatus constructed, arranged and operating substantially as described with reference to Figures 1 to 5 of the accompanying drawings.

24. A receiving apparatus constructed, arranged and operating substantially as described with reference to Figures 6 to 9 of the accompanying drawings.

Dated this 22nd day of June, 1938.

D. YOUNG & CO.,
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Agents for the Applicants.

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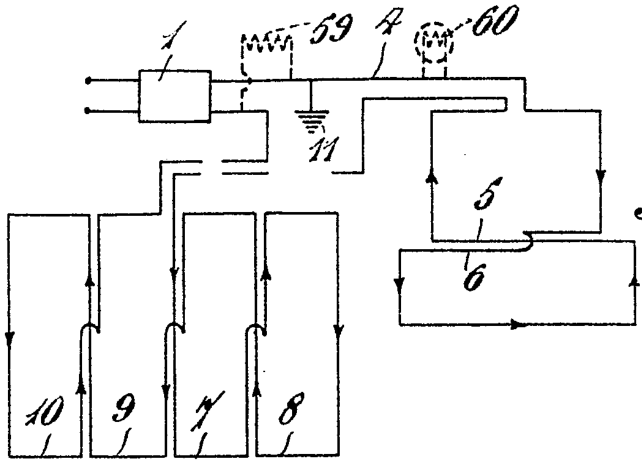


Fig. 1.

Fig. 2.

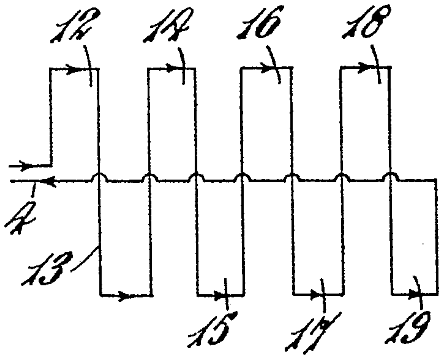


Fig. 3.

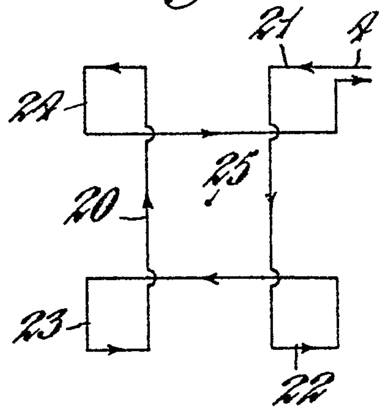


Fig. 4.

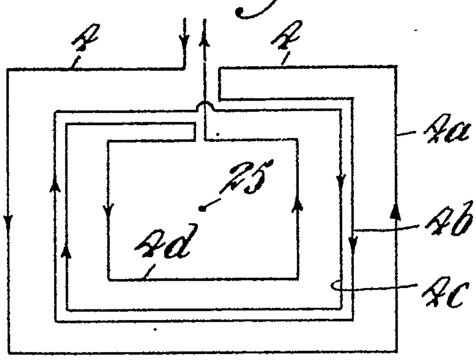


Fig. 5.

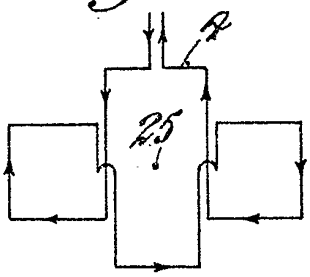


Fig. 6.

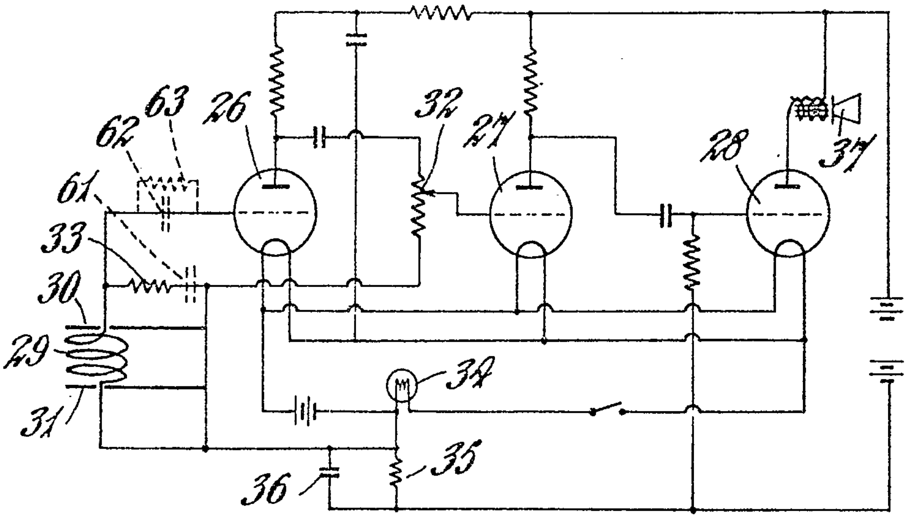
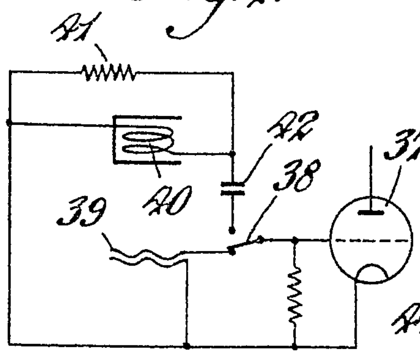


Fig. 7.



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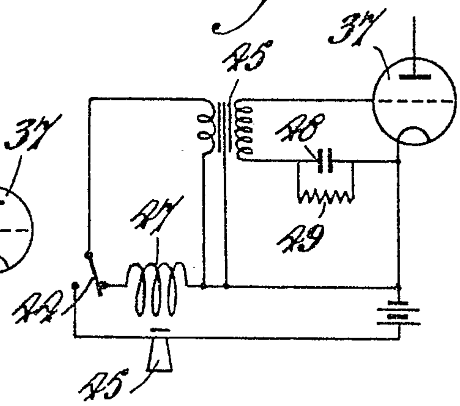

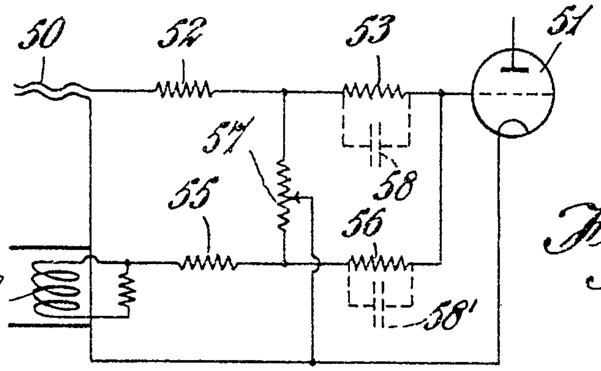

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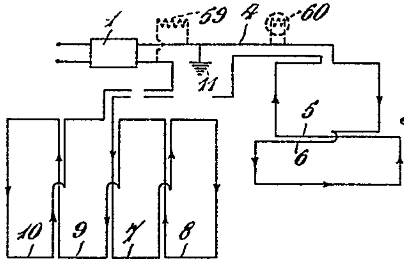
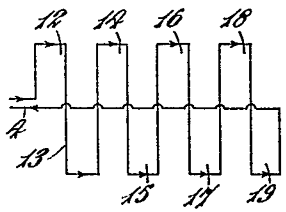


Fig. 1.

Fig. 2.



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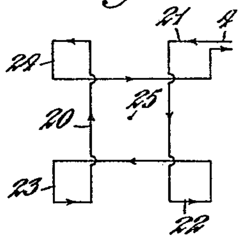

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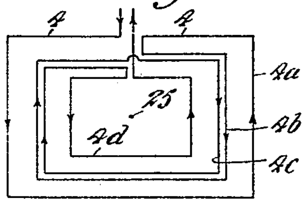

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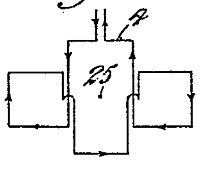

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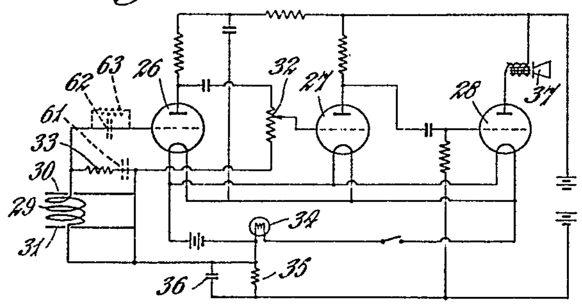
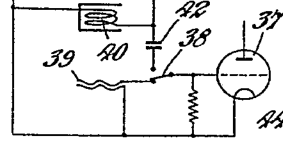


Fig. 7.



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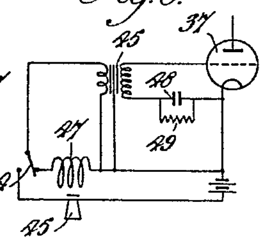

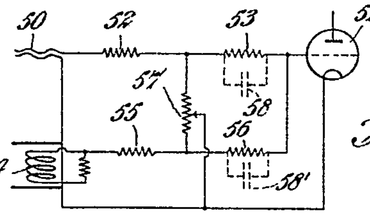

Fig. 9.

[This Drawing is a reproduction of the Original on a reduced scale.]