Aug. 4, 1931. W. B. JONES 1,817,489

SOUND TRANSMISSION

Filed Dec. 5, 1928

Fig. 1

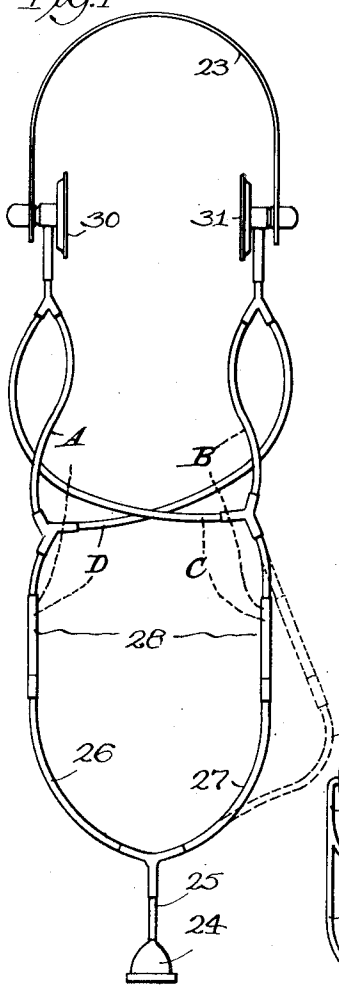


Fig. 2

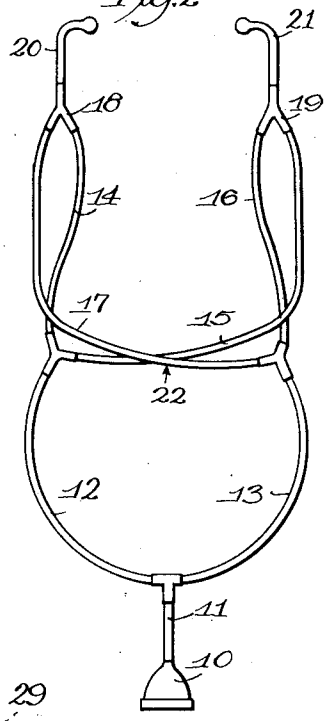


Fig. 3

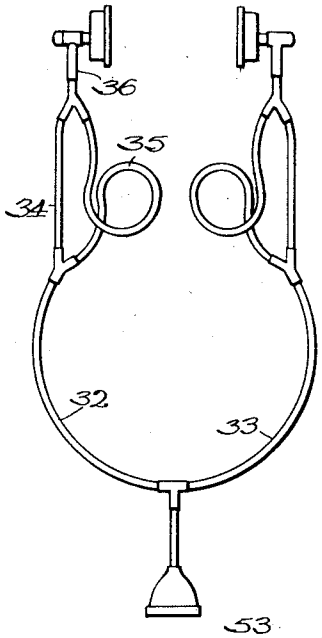


Fig. 4

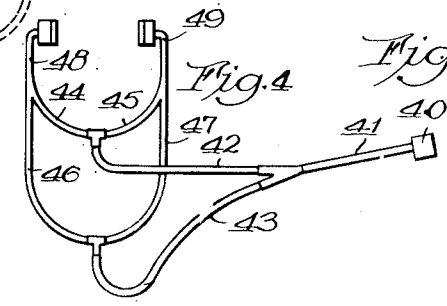


Fig. 5

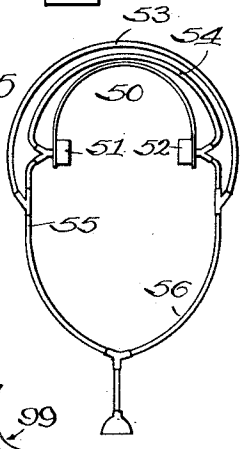


Fig. 6

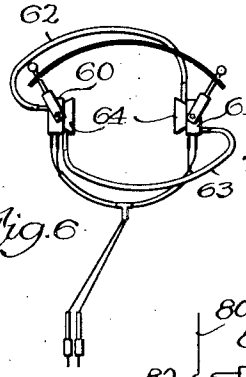


Fig. 7

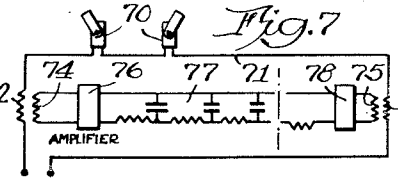


Fig. 9

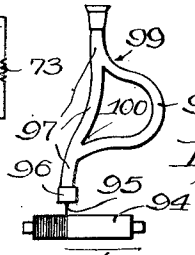
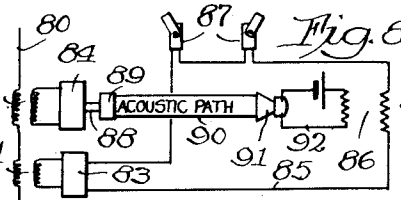


Fig. 8



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Patented Aug. 4, 1931 1,817,489

UNITED STATES PATENT OFFICE

W. BARTLETT JONES, OF CHICAGO, ILLINOIS

SOUND TRANSMISSION

Application filed December 5, 1928. Serial No. 323,886.

The present invention relates generally to sound transmission and reception, and in particular to apparatus such as stethoscopes and the like, far example the ear pieces and tube connections used with dictating machines, or those employed in other phonographic reproduction.

The present invention has resulted from a study of certain peculiarities in the sense of hearing, regarding the reception of sounds by the ears, having particular reference to the first reception by one ear and to a subsequent reception of the same sound by the other ear.

It is well known that sound is improved in quality by the reception of reflected portions of the sound, such as those which may reach the ear from the walls of an auditorium. It is also known that when the reflected wave is more than eighty feet behind the primary wave, the two do not merge into one sound but create an echo. This is the maximum limit for lagging waves. It is also known that when one ear hears a sound before the other ear, and the time interval between receptions by the two ears is less than the so-called binaural limit, the sound appears at some definite angle to the listener; and that if both ears hear the same sound at the same time, the sound appears to come from a direction directly ahead or behind the listener.

I have noted that after sound is heard in one ear and when the other ear receives the same sound after an interval greater than the binaural limit, the sound reception in no way changes the perceived direction of the sound, but it does markedly change the character and quality of the sound. To illustrate: A sound is conveyed, say by rubber tubing, to the ear R. If the ear L receives the same sound at a later interval greater than the binaural limit, the hearing of sound is not apparent in the ear L, but the sound which is being heard by the ear R is stronger, fuller, and more natural, and has a generally improved quality.

I have found that this holds true for both ears simultaneously, and that each ear may be treated to sound first heard by the other ear, using an extra-binaural interval, without affecting the ability of the sense of hearing to perceive direction by measuring the time interval between the two receptions of the primary sound.

In stethoscopes, and in phonographic receiving apparatus which carry sound to the ears, it has long been the practice to convey the sound in one path, and then to split it into two paths, usually of equal length for presentation to the two ears. The sounds thus heard are not the most natural sounds that can be obtained from a single tube. In such apparatus the present invention aims to divide and distribute the sound from a single source so that it may be received by the two ears with a more natural effect.

Because of the more general use of dictating machines the invention will be specifically described with reference to devices and practices in this field. In this use of such devices typists are obliged to sit for long periods of time, typing words received by them at ear pieces from a phonograph record of the dictation. The more unnatural the sounds heard, the more strain there is on the operator. Furthermore, the listener's hearing may be defective, and there is now no provision for adjustments of the device to suit the hearing characteristics of the listener.

I have found that by several simple changes in the devices now in use, a greatly improved reception can be obtained. I believe I have discovered a principle which can be applied in a variety of fields in sound reception and transmission, as will appear more fully hereinafter from the description of the various devices illustrated in the accompanying drawings, in which:

Fig. 1 illustrates ear-pieces and connections for a dictating machine typist.

Figs. 2, 3, 4 and 5 are modifications of similar apparatus.

Fig. 6 is a view showing a set of head-phones modified acoustically for improved reception.

Fig. 7 represents a set of head-phones with electrical mechanism to improve the acoustical presentation of sound.

Fig. 8 represents a set of head phones with

combined acoustic and electric mechanism to improve the presentation.

Fig. 9 represents an adaptation of the principle to the recording of dictation.

I will first describe the apparatus shown in Fig. 2. Numeral 10 represents a single source of sound, such as the diaphragm on a stethoscope, a dictation phonograph, or a telephone receiver. The reproduced sound is conveyed by a tube 11 and split into two branches 12 and 13, which in turn are respectively split into two branches 14—15 and 16—17. Branches 15 and 17 are made to cross each other, and are much longer than the companion branches 16 and 14. Branches 14 and 17 are combined by a Y-connector 18, and branches 15 and 16 are combined by a Y-connector 19. Ear pieces 20 and 21 present the recombined sounds to the ears.

It will be observed that paths 11—12—14—18—20 and 11—13—16—19—21 are illustrated as equal in length and are shorter than the other pair of equal length paths 11—12—15—19—21 and 11—13—17—18—20. Therefore, each ear receives the same combination of sounds at the same time. But each combination has a leading or primary component and a lagging or secondary component. Should the tubes be pinched at the region 22, so as to cut off both crossing connections, the secondary components become eliminated and the primary wave of the apparatus 10 is heard in each ear. The character of the sound will be rendered inferior by the pinching described, and improved hearing will be established upon release of the tubes from the pinched condition. Each ear then receives the primary components at the same time, and later, each ear hears the same sound after an interval corresponding to the added length of path. The improved hearing for each ear is due to the combined first hearing in that ear and the second hearing of the other ear.

I have found that when the delayed sound lags a distance greater than the binaural limit, the time interval between the primary waves can be varied within the binaural limit, to indicate direction or angularity of source, or to move the apparent source angularly to the listener. This permits adjustment of the apparent source of sound to abnormalities in hearing. Even for normal persons it permits sound to be placed more to the side where other disturbing noises may be heard, so as to overcome such disturbance.

Fig. 1 shows how this can be done. A head-gear 23 is connected as in Fig. 2 above described. The source 24 (corresponding in character to source 10 in Fig. 2) is connected by a tube 25 which is split into two paths 26 and 27, each branch path containing telescopic tubular connectors 28 for varying the lengths of the paths 26 and 27. When path 27 is elongated into the length indicated in dotted line path, ear-piece 30 receives the primary wave before ear-piece 31. The lagging secondary wave in ear-piece 31, which is the mate for the primary wave in ear-piece 30, remains unchanged, and the lagging secondary wave in ear-piece 30 is additionally delayed equally with its companion primary wave in ear-piece 31.

In Fig. 1 four paths are created which are designated A, B, C, and D. Paths A and B are the shortest paths to the two ears and through a lengthening of path 27 to the length 29 they may vary within the binaural limit to favor one ear earlier than the other ear. The paths C and D are respectively longer than the paths B and A by a length greater than the binaural limit, so that after one ear hears sound through A (or B) the other ear hears the same sound through D (or C) after an interval too late to determine a directional effect.

In Fig. 3 the crossing connection is eliminated and each of the two branches 32 and 33 divide into a short branch 34 and a longer branch 35, which are recombined at 36. The net effect is the same, but I have observed that better results are obtained in the connections of Figs. 1 and 2. In explanation of this observation I submit that the companion primary and secondary effects heard by the two ears should be as nearly identical as possible. In Fig. 2 the secondary wave in tube 16 is taken off from the companion primary wave in tube-path 12—14. In Fig. 3 the paths of the companion waves have a less length in common and are independent over a greater length, permitting move variation in transmission to result by internal reflections from the tube walls.

In Fig. 4 a common source 40 is attached to a tube 41, which is split into two branches 42 and 43, which are respectively split into two branches 44—45 and 46—47. Branches 43—46 and 43—47 are made longer than branches 42—44 and 45—42. A combination of long and short branches is made for each ear at 48 and 49.

Fig. 5 is an improved arrangement in which a head-gear 50 having ear-pieces 51 and 52 is employed as a carrying bridge for acoustic tubes 53 and 54. Each ear-piece receives the primary wave from the tube 55 or 56, each of which is tapped by one of the tubes 53 and 54 that leads to the opposite ear-piece.

Fig. 6 shows a pair of head-phones 60 and 61 into the backs of which acoustic tubes 62 and 63 are connected for carrying sound from one phone to the ear at the opposite phone. An ear-piece 64 is provided over each phone to receive the acoustic tube.

Fig. 7 illustrates how to accomplish the purposes of the invention electrically. A pair of head-phones 70 is connected in circuit 71 with two transformer or induction coils 72

and 73 coupled respectively to coils 74 and 75, interconnected by an amplifier 76, if one is necessary, a delay circuit 77, and an amplifier 78 (if necessary). The length of the delay circuit and the use of amplifiers may be proportioned to secure the desired volume in the lagging waves in each of the ear-phones.

In the circuit of Fig. 7 the delayed sound wave again becomes operative upon the delay circuit to provide a further delay, causing continued repetition of the sound. It is to be understood that the delay period and the intensity of the first delayed sound should be controlled to prevent building up of the delayed waves to overcome the primary wave, and to permit the delayed waves to die out. The intensity of the delayed wave should therefore be made less than the primary wave, and no delayed wave of about an eighty-foot lag should be heard. It should also be understood that the multiplication of the delayed waves can be avoided by introducing an additional circuit, according to the principles involved in Fig. 8.

In Fig. 8 an acoustic path is employed as delaying means. A line 80 carrying current corresponding to sound has two induction means 81 and 82 in its circuit. These are respectively coupled to a head-phone circuit and a delaying circuit through suitable coupling, regulating or amplifying apparatus 83 and 84. The head-phone circuit 85 has induction means 86 therein and head-phones 87. The delay circuit 88 contains a sound producer 89 operating over an acoustic path 90 into a pick-up device such as a telephone transmitter 91 in a local circuit 92 coupled to the induction means 86 of circuit 85.

The devices of Figs. 1 to 8 are directed to the receiving end, or the transmission of sound or records of sound to the ears of a listener for improved reception. With reference to the dictation phonograph field it is to be understood that the devices shown and herein described are particularly adapted to be used with records made by voice through a simple length of speaking tube which records the primary sound wave of the voice. The devices of this invention serve to compound the recorded wave with itself in a different phase relation.

The same result as above described may be effected prior to making the record, so that the record contains the same type of compound wave. In Fig. 9 I show means for doing this. The device herein shown compounds the wave in an acoustic path by bypassing one portion into a longer or delaying channel, so that when the two are reunited, the original and the by-passed portion are compounded in an out-of-phase relation. In Fig. 9 a record is indicated at 94, a cutting stylus at 95, and the stylus box at 96. The main speaking tube 97 has a by-pass 98 arranged to divert about half the sound energy into the longer path at the point 99, and to reunite the two portions at 100.

The record 94 may be used with the usual Y-type of head-gear connection now in use to obtain the desired effects of this invention, or it may be used with the improved apparatus to improve the hearing to a still greater degree by the additional delayed waves that are impressed on the ear.

From the foregoing it will be apparent to those skilled in the art that a number of different embodiments are possible as contemplated by the scope of the appended claims.

I claim:

1. The method of transmitting an original sound to human ears which comprises, converting a wave form corresponding to said sound into two similar portions, delaying one portion relative to the other portion, recombining the out-of-phase wave forms, converting the resulting wave form into two portions, and presenting the divided portions as sound separately to each ear.

2. The method of transmitting an original sound to human ears which comprises presenting said sound separately to each ear at intervals less than the binaural limit, and subsequently presenting the said sound to each ear.

3. The method of transmitting sound to human ears which comprises presenting primary sound to each ear, delaying said sound to form secondary sound, and subsequently presenting the secondary sound to each ear.

4. The method of transmitting sound to human ears which comprises presenting sound to one ear, and conducting the same sound to the other ear over an acoustic path which is sufficiently long to delay its arrival for a period not less than the binaural time limit.

5. The method of transmitting sound to human ears which comprises conducting sound through an acoustic path to one ear and conducting the same sound to the other ear through an acoustic path which is longer by an amount not less than the binaural time limit.

6. The method of transmitting sound to human ears which comprises conducting sound through separate acoustic paths to each ear at intervals less than the binaural time limit, and conducting the same sound to each ear over an acoustic path which for one ear is longer than the path to the other ear by an amount not less than the binaural limit.

7. The method of transmitting sound to human ears which comprises conducting sound through separate acoustic paths to each ear at intervals less than the binaural limit, and conducting the same sounds to each ear over an acoustic path which for any

one ear is longer than the path to the other ear by an amount not less than the binaural limit, and controlling the time of arrival over the shorter paths at the respective ears, in accordance with the particular characteristic of the individual.

8. Apparatus for hearing sound which comprises an acoustic ear piece for each ear, two means of unequal length forming two acoustic paths to each ear piece, two Y-means having each three acoustic branch paths, said four-path forming means being connected in any way to four branches of the Y-means leaving one unconnected branch on each Y, and means for delivering the same sounds to each remaining Y-branch.

9. Apparatus for hearing sound which comprises an acoustic ear piece for each ear, two means of unequal length forming two acoustic paths to each ear piece, two Y-means having each three acoustic paths, said four means being connected in any way to four branches of the Y-means leaving one branch on each Y-means unconnected, two means forming acoustic paths of equal lengths, a third acoustic path Y-means connecting said equal length means, the remaining branch of the third Y being adapted to receive a single sound.

10. Apparatus for bearing sound which comprises in combination, means forming an acoustic path for sound, said means dividing the path into two acoustic branches, means dividing each branch path into two sub-branches, the total lengths of two paths from the first division varying less than the binaural limit, the shorter being A and the longer B, the length of the remaining paths from the first division being such that one of them C is longer than A by an amount not less than the binaural limit, and the other D being similarly longer than B, ear pieces for each ear, A and C being connected to one ear piece and B and D to another ear piece.

11. The method of picking up sound for making a record or a transmissible effect thereof which comprises picking up a primary wave of said sound in a pick-up device, by-passing a portion of said primary wave in an acoustic path, and returning said by-passed sound to the pick-up device after expiration of the binaural time limit.

In tesimony whereof, I have hereunto affixed my signature.

W. BARTLETT JONES.