

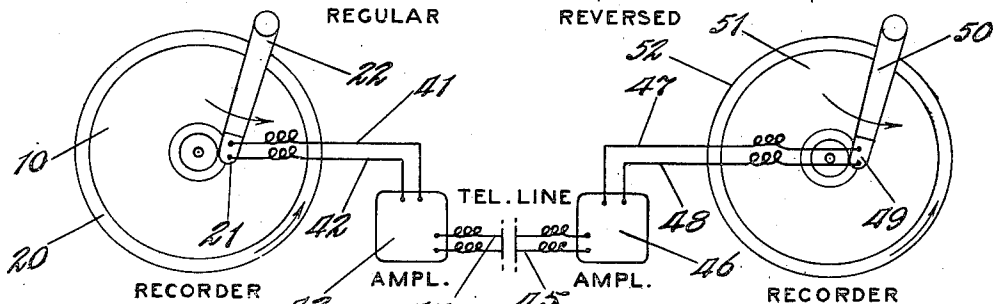
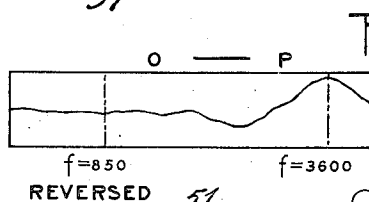
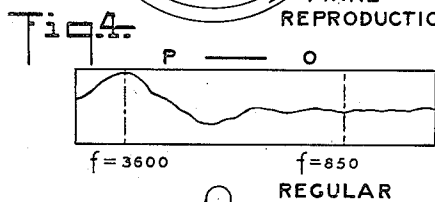
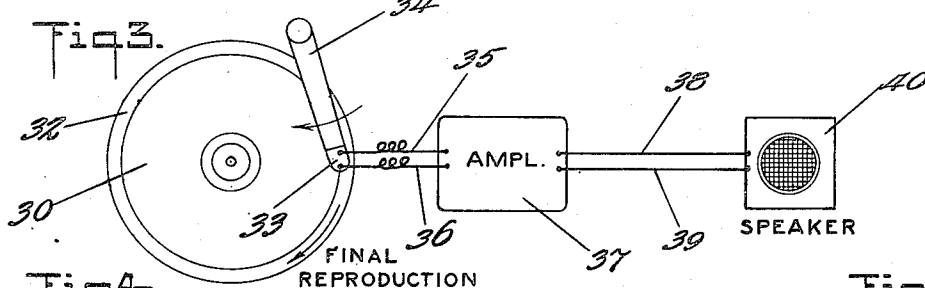
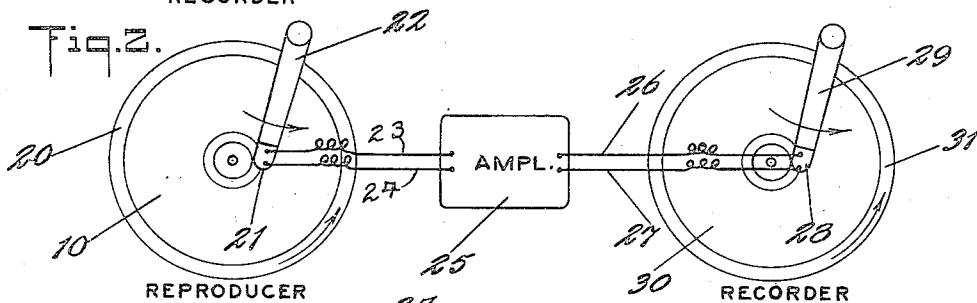
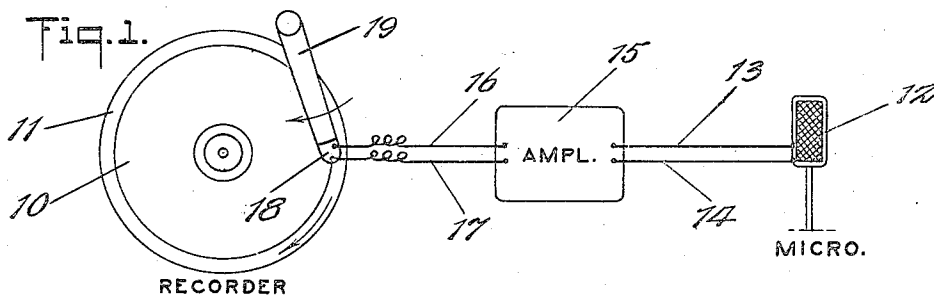
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REVERSE RE-RECORDING SYSTEM

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REVERSE RE-RECORDING SYSTEM

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This invention relates to phonographs, and more particularly to an improved method of re-recording speech and sound with the minimum loss of clarity, fidelity, and intelligibility.

One object of this invention is to provide a method of the above nature in which the re-recording is done in two steps, first reproducing the sound from the original record in the reverse direction from that at which it was recorded and simultaneously recording it on a reversed record, and then reproducing the sound from said reversed record in the original direction.

A further object is to provide an improved method of the above nature which will be simple in operation, easy to manipulate and extremely efficient in use.

With these and other objects in view, there has been illustrated on the accompanying drawing one form in which the invention may conveniently be carried out in practice.

In making copies of original sound records it has been common in the past, in order to preserve the intelligibility of the high frequencies of the original recording, to reduce the speed of the reproduction and rerecord the sound waves at a slower speed than that of the original recording. If the rerecording was made at the same or higher speed than that of the original recording, high frequency losses would be introduced, and it has hitherto been thought impossible to rerecord from a sound record at a speed greater than the original recording without serious distortion.

By means of the present invention, the above and other disadvantages and limitations have been avoided. This has been accomplished by making use of the important discovery that by reproducing and rerecording the original record backwards, or in the reverse direction from that at which it was originally recorded, a reversed record can be obtained at relatively high speed and with the minimum loss of clarity both in the low and high frequency sound waves. By then playing the reversed record in the original direction an almost exact reproduction of the original record may be produced with practically no loss of intelligibility.

While the explanation for this phenomenon is not entirely understood, the improved results obtained are due to the fact that the "reversal" speech from the original record may be transmitted from the reverse reproducing pickup through the other elements of the reproducing and rerecording system with less loss than if the rerecording was done in the same direction as the original recording.

Acoustic investigations have shown that in a spoken vowel sound, there is on the average, first a short period of rapid growth in amplitude lasting about 0.04 second, during which all com-

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ponents of the sound are quickly produced and rise nearly to maximum amplitude; second, a middle period lasting about .16 second; and third, a final period of gradual decay, lasting about .09 second, thus bringing the total length to approximately 0.29 second.

In many vowel sounds, the vocal cords act only as an agent for exciting the transient frequencies which are characteristic of the vocal cavities. Thus, a puff of air from the glottis sets the air in these cavities into vibration. This vibration soon diminishes, dampens, or decays until it is started anew by a second puff, the different puffs succeeding each other quite regularly. The resultant sound waves therefore are of large amplitude at the beginning of the wave and gradually die away toward the end.

In the production of vowels, the vocal cords start a train of sound waves which have impressed upon them certain resonant characteristics due to the vibration of the throat, mouth, and nasal cavities. Consonants are produced by passing the air through small openings or over sharp edges in the mouth. Consonant sounds have an impulsive and explosive quality which is due to the fact that they are more suddenly released and have steeper wave-fronts.

Speech consists of steady vowel tones emitted by the vocal organs combined with consonants produced by interruptions caused by tongue and mouth movements. It is a well recognized fact that most words of common speech start with consonants.

Vowel sounds are mostly of low frequency and hence are relatively easy to record and transmit without distortion. Consonants, on the other hand contain a considerable amount of transient high-frequency components and provide more difficulty in the recording and transmission processes. This is particularly true when any part of the phonographic mechanism is susceptible to "shock excitation." In such a case, the holding over of the shock excitation due to the "explosive" consonant causes the reproduced word to be blurred.

Whenever, however, the recorded sound waves are reversed by rerecording in the method of the present invention, the explosive impulses of the consonants are in most words preceded by a steady vowel sound. Thus, instead of a loud initial impact, starting "instantaneously" and then gradually diminishing, as in the original sound, the reverse will be true in the reproduced and rerecorded word on the reversed record—i. e., the wave will gradually build up from the normal low level of a vowel to the maximum high level of a consonant. In this manner, the blurring due to shock excitation will be much less serious in the tracing of the reversed speech waves.

The above may be illustrated by way of exam-

ple with the simple word "Po," the sound wave of which is shown in Figure 4. During the speaking of this word the lips open suddenly to release the initial consonant "p" in an explosive manner and may act to "shock excite" some part of the phonograph mechanism such as the microphone, the amplifier, the recording head or the "pickup." The vocal cords then vibrate to produce the vowel sound "o."

The original recorded sound will then be played back reversed, creating an effect much as if the reversed word "Op" were made by "sucking" in the sounds, starting with the vowel "o" and ending with the consonant "p." This is clearly shown in Figure 5.

In the drawing:

Figure 1 represents a diagrammatic view of a disk phonograph recording mechanism.

Figure 2 is a diagrammatic view of a mechanism for reversely reproducing the original record coupled with an amplifier and a mechanism for rerecording the sound on a reversed record.

Figure 3 is a diagrammatic view of a mechanism for reproducing the reversed record in the direction of the original recording.

Figure 4 is a time-amplitude chart representing the growth and decay of the energy of the sound waves of the word "Po" in an original record.

Figure 5 is a sound energy chart similar to Figure 4 representing the appearance of the word "Po" when recorded on the reversed record.

Figure 6 is a diagrammatic view of a modified form of the invention in which the reverse recording is done over a long telephone line employing an amplifier at each end thereof.

Referring now to the drawings in which like reference numerals denote corresponding parts throughout the several views, the numeral 10 indicates an original disk record mounted on a turntable 11, and driven in a clockwise direction, as indicated by the arrow in Figure 1, by suitable mechanism not shown. The speech or other sounds to be recorded on the original record are received by a microphone 12, connected by conductors 13, 14 to an amplifier 15 the output terminals of which are connected by conductors 16, 17 to a recording head 18, mounted to be swung inwardly, as indicated, across the surface of the record 10 by an arm 19 driven by a suitable feed mechanism, not shown.

To make copies of the original record 10 by the method of the present invention, said record 10 will be placed on a reproducing phonograph turntable 20 which is driven in a counter-clockwise direction, as indicated by the arrow on Figure 2 by suitable mechanism, not shown. The sound waves originally recorded on the record 10 will thus be reproduced or played back in the reverse direction from that in which they were recorded, by a pickup 21, carried by an arm 22 which is adapted to swing outwardly, as indicated. The pickup 21 is connected by conductors 23, 24 to an amplifier 25, which in turn is connected by conductors 26, 27 to a recording head 28 of a recorder arm 29 which is swung outwardly across a reversed disk record 30 by suitable feed mechanism, not shown. The record 30 is mounted on a turntable 31 driven in a counter-clockwise direction by suitable mechanism, not shown.

The final step of the present rerecording method is to place the reversed disk record 30 upon a reproducing turntable 32, driven in the original clockwise direction, as indicated.

The sound waves recorded on the reversed record 30 will be again reproduced by means of a pickup 33 mounted on an arm 34 adapted to swing inwardly across the record 30. The pickup 33 is connected by conductors 35, 36 to an amplifier 37, the output terminals of which are fed through conductors 38, 39 to a loud-speaker 40.

In the modified method of rerecording illustrated in Figure 6, the disk record 10 will be mounted on the reproducing turntable 20 driven in a counter-clockwise direction and reproduced by the pickup 21 carried by the outwardly-swinging arm 22 in the same manner as in the first method illustrated in Figure 2. The output of the pickup 21 will then be transmitted through a pair of conductors 41, 42 to an amplifier 43. From the amplifier 43, the energy will be transmitted through a pair of long telephone line conductors 44, 45 to a second amplifier 46 located at the other end of the line. The output of the amplifier 46 is connected by conductors 47, 48 to a recording head 49 carried by an arm 50 which is swung across a reversed disk record 51 by suitable feed mechanism, not shown. The record 51 is mounted on a turntable 52 which is driven in a counter-clockwise direction, by suitable mechanism, not shown.

In using the mechanism shown in Figure 6 for carrying out the modified method, the original record 10 will be played back on the turntable 20 and transmitted reversed or "garbled," over the telephone line 44, 45.

It will be clear that the original excellent quality of the record will thus be preserved and carried over said line without the imposition of the "shock-excitation" effects commonly introduced when records are rerecorded over telephone lines in the usual non-reversed manner.

One advantage of this modified method of rerecording is that a much better final recording over a long telephone line may be obtained than was previously possible by direct transmission from a microphone connected directly to the line.

Another advantage of the present invention is that it is possible not only to obtain a better quality of reproduction when operated at the same speed as the original sound record, than was possible with the previous conventional systems, but also to obtain intelligible quality when rerecording at a much greater speed.

This result is of especial advantage in the transmission of telephone and radio communications, where the incoming speech messages are pre-recorded on records, prior to retransmission to other points over a telephone line or on a radio beam. By the present invention, the original pre-recorded sounds may be transmitted reversed at high speed for re-recording on a reversed record at the receiving station—the sound on said reversed record thus being "garbled" or rendered unintelligible. The "garbled" reversed record may then be again reproduced in the original direction at the receiving station to render it intelligible as described above.

While there has been disclosed in this specification one form in which the invention may be embodied, it is to be understood that this form is shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosure but may be modified and embodied in various other forms without departing from its spirit. In short, the invention includes all the modifications and embodiments coming within the scope of the following claims.

Having thus fully described the invention what

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is claimed as new, and for which it is desired to secure Letters Patent is:

1. In a recording-reproducing system, a record member, recording means including a tipped stylus for grooving said record member in accordance with a signal, means for moving said record member and said recording means with respect to each other at a given rate and in a given direction while said signal is being recorded on said record member, reproducing means including a tipped stylus for riding in said groove in said record member to reproduce the recorded signal, means for moving said record member and said reproducing means with respect to each other at a rate greater than said given rate and in a direction opposite to said given direction while said signal is being reproduced.

2. In a recording-reproducing system, a first record member, first recording means including a tipped stylus for grooving said record member in accordance with a signal, means for moving said record member and said recording means with respect to each other at a given rate and in a given direction while said signal is being recorded on said record member, first reproducing means including a tipped stylus for riding in said groove in said record member to reproduce the recorded signal, means for moving said record

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member and said reproducing means with respect to each other in a direction opposite to said given direction while said record is being reproduced, a second record member spaced from said first record member, second recording means including a tipped stylus for grooving said second record member in accordance with a signal, transmission means connected to said first reproducing means and to said second recording means whereby said second recording means records said signal in a reverse direction and at a location distant from said first recording means, second reproducing means including a tipped stylus for riding in said groove in said second record member to reproduce the recorded signal, and means for moving said second record member with respect to said second reproducing means in a direction such that said reproduced signal is in its forward sequence.

LINCOLN THOMPSON.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Country	Date
329,775	Great Britain	May 29, 1930