April 11, 1933. J. C. SNYDER 1,903,487

SOUND RECORDING AND REPRODUCING APPARATUS

Filed July 7, 1930 3 Sheets-Sheet 1

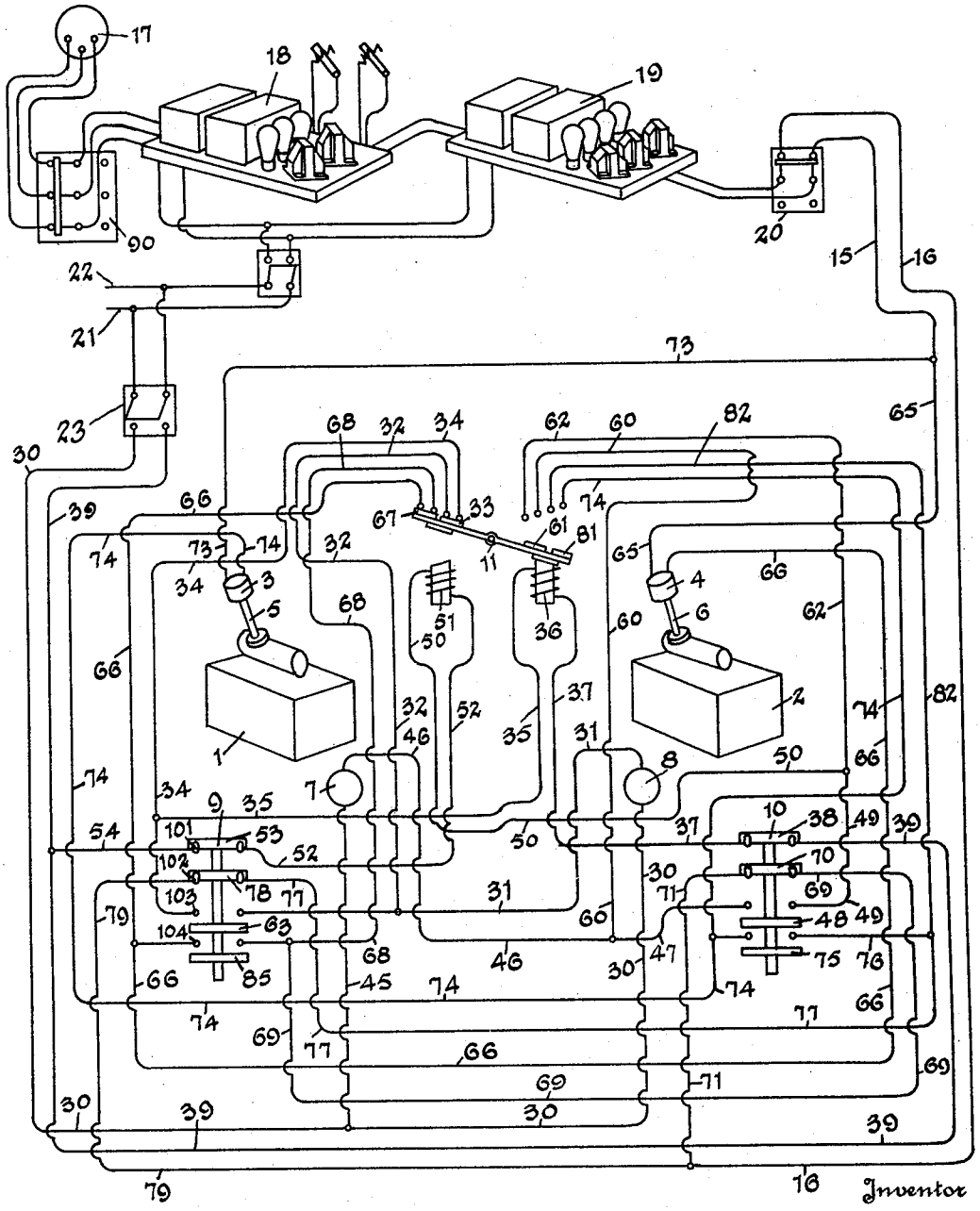


Fig 1

Inventor

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SOUND RECORDING AND REPRODUCING APPARATUS

Filed July 7, 1930 3 Sheets-Sheet 2

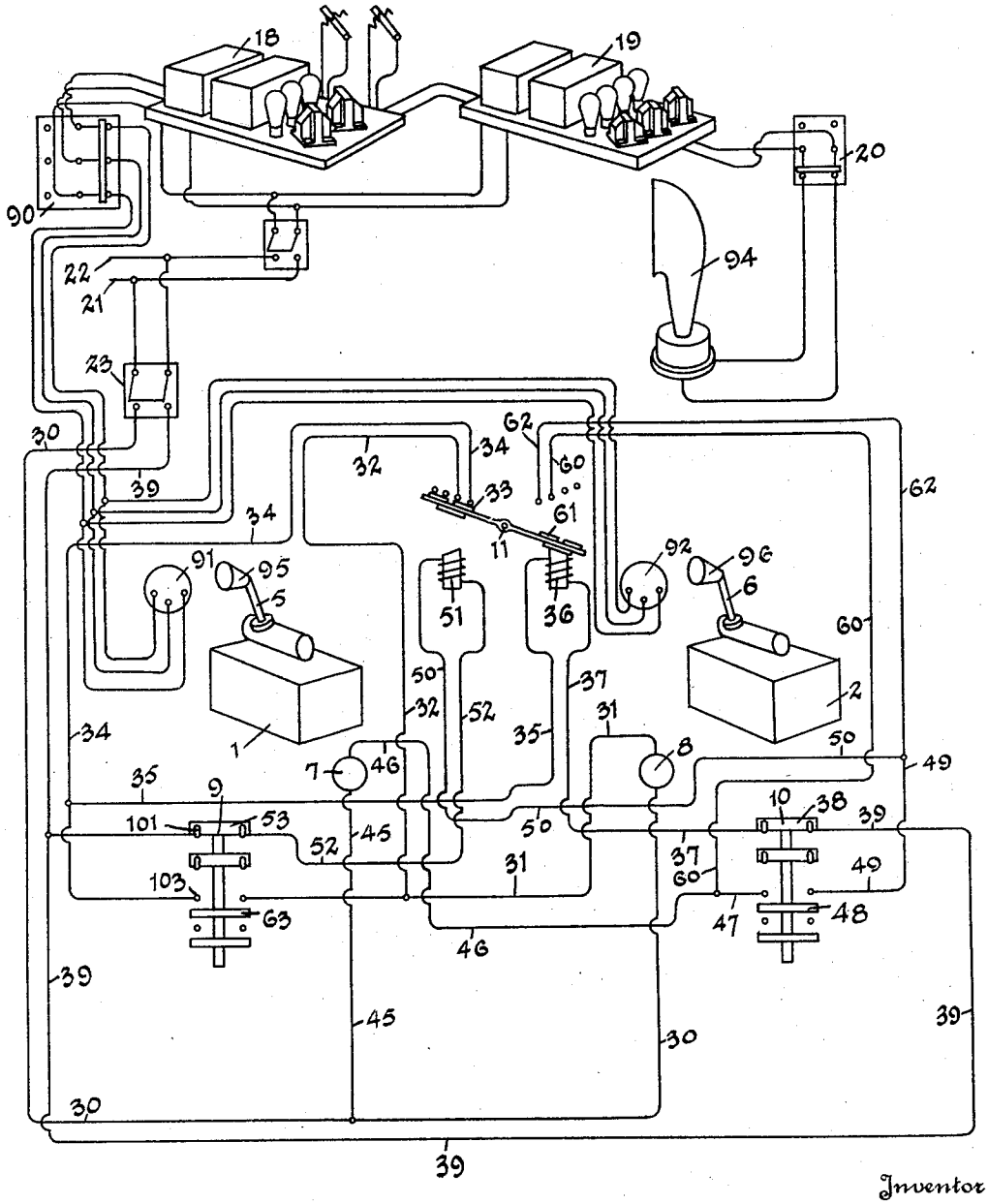


Fig 2.

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SOUND RECORDING AND REPRODUCING APPARATUS

Filed July 7, 1930 3 Sheets-Sheet 3

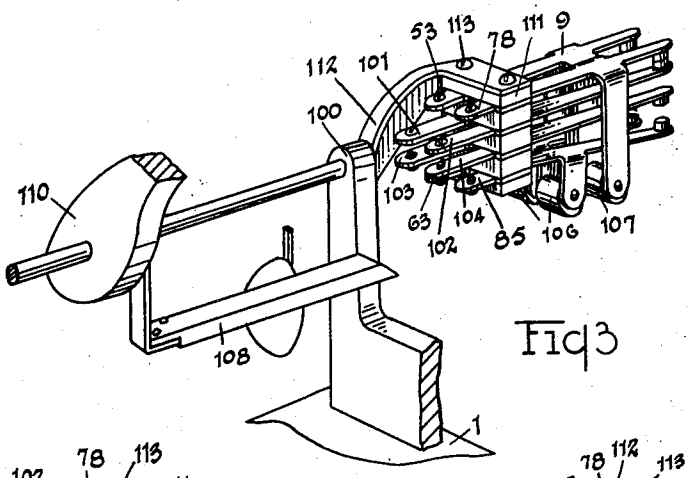


Fig 3

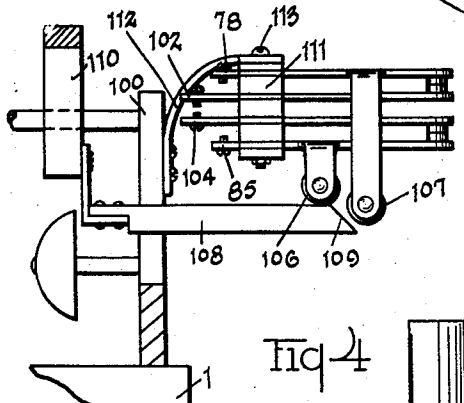


Fig 4

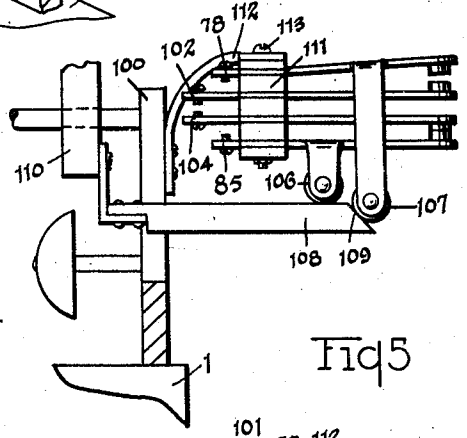


Fig 5

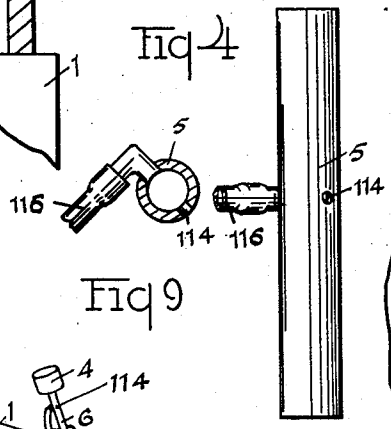


Fig 9

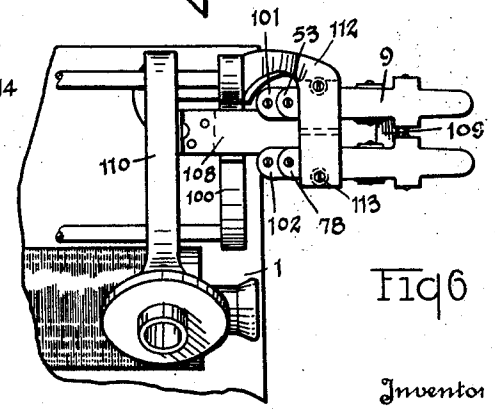


Fig 6

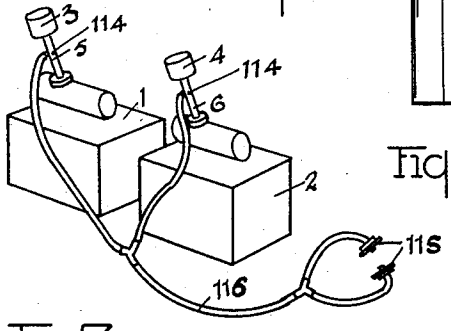


Fig 7

Fig 8

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Patented Apr. 11, 1933 1,903,487

UNITED STATES PATENT OFFICE

JAY C. SNYDER, OF TOLEDO, OHIO

SOUND RECORDING AND REPRODUCING APPARATUS

Application filed July 7, 1930. Serial No. 466,099.

My invention has for its object to provide a recording system for recording sounds at a point remote from their production. The invention is particularly of value when used for the recording of statements or testimony. The records, that are thus made, are permanent or semi-permanent in character and the statements or testimony may be reproduced when desired.

The invention may be used for a great variety of purposes where recording of sound may be advantageously used, and, to illustrate a practical application of the invention, I have selected a system containing the invention as an example of the various systems that embody the invention, and shall describe it hereinafter. The system and parts pertaining thereto are shown in the accompanying drawings.

Fig. 1 is a diagram of the connection between the parts of the system during the recording of the sound. Fig. 2 illustrates the system to reproduce the recorded sound. Many of the connections of the system not used in reproduction, and shown in Fig. 1, are omitted from the diagrammatic showing contained in Fig. 2. Fig. 3 is a perspective view of a control switch associated with each of two phonographs whereby sound may be recorded on portions of both phonographs during short intervals of time, particularly just in advance of the completion of the operation of the recording means on one of the cylinders to produce overlapping records of the same sounds. Fig. 4 illustrates a side view of the switch that shows the parts thereof when in a position different from that shown in Fig. 3. Fig. 5 is a view similar to that shown in Fig. 4, parts of the switch being shown in still other positions. Fig. 6 is a top view of the switch and of parts of the phonographs with which it is associated. Fig. 7 is a diagrammatic illustration of the connection of ear phones for determining the proper operation of the recording apparatus. Fig. 8 is a side view of a sound transmission tube. Fig. 9 is a view of a section of the tube illustrated in Fig. 8.

For the recording of the sounds, a pair of phonographs 1 and 2 are, preferably, used, which are electrically interconnected to operate in rotation with each other upon the completion of the receiving surface area of one of the cylinders, the cylinders being placed in succession upon each of the phonographs. Each phonograph is provided with an electrically operated speaker, such as the speakers, 3 and 4, which are supported by means of sound transmission tubes 5 and 6 on the carriages of the phonographs and which communicate the sounds to the usual phonographic diaphragm. As customary in connection with phonographs, the phonographic diaphragm is provided with a needle in each case for sound cutting the wax cylinders that are placed upon the mandrel rotatably supported on the base of the phonographs and operated by the motor of the phonograph in the manner well known in the art. The motors 7 and 8 operate the phonographs 1 and 2, respectively, and are controlled by switches 9 and 10. The switch 9 controls the starting of the phonograph 2 and the cessation of the operations of the phonograph 1, while the switch 10 operates in the same manner to control the starting of the phonograph 1, and the cessation of the operations of the phonograph 2. Thus the switches 9 and 10 are dependent upon the operations of the phonographs, particularly, the movements of the carriage of the phonograph, as produced by the motors 7 and 8.

The electromagnetic switch 11 operates to maintain certain circuits of the switches 9 and 10 closed until one or the other switches has been operated by the carriages.

Sound is electrically transmitted to the apparatus through the lines 15 and 16. Preferably, the electric sound waves are greatly magnified in order to produce a vibration of large amplitude in the diaphragms of the phonographs. This is obtained by the use of the microphone 17 that is connected to the transmission amplifier 18 and a receiving amplifier 19, which is connected by a suitable switch 20 through the lines 15 and 16 that lead to the speakers 3 and 4 of the phonographs. The amplifiers 18 and 19 may be con-

nected with a source of supply of current, such as is indicated by the main line wires 21 and 22. The motors 7 and 8 are also connected to the source of supply through the main line wires 21 and 22 to which they may be connected by means of the switch 23.

In the operation of the apparatus, the initial positions of the switches 9, 10, and 11, will be such as to cause one of the motors 7 and 8 to be connected to the main lines 21 and 22 and one of the speakers 3 or 4 of the lines 15 and 16. When, therefore, it is desired to receive the sound occurring at the microphone 17, the switch 23 is closed and the sound that is electrically transmitted through the lines 15 and 16 will be received on one of the wax cylinders located in position on the phonographs 1 or 2. Assuming that the sound is being received by the phonograph 2, the circuit is from the main supply line 21 through the line 30 to the motor 8, through the lines 31 and 32, movable contact 33 of the switch 11, lines 34 and 35, through the coil 36 of the switch 11, and the line 37, through the movable contact 38 of the switch 10, and the line 39 to the main line 22. Thus the motor 8 continues to operate until the carriage of the phonograph 2 operates the switch 10, which occurs in advance of the completion of the impressions received by the wax cylinder of the phonograph 2. The circuit of the motor 8 is maintained by the switch 11 and the switch 10, but the operation of the switch 10 also initiates the operation of the motor 7 of the phonograph 1. The circuit of the motor 7 is from the main line 21 to the line 30, the line 45, the motor 7, line 46, line 47, the movable contact 48, the line 49, line 50, the coil 51, line 52, the movable contact 53, line 54 to the line 39 which is connected to the main line 22.

There is thus a current flowing through both coils 36 and 51 and, owing to the position that the switch 11 is in, it is under the control of the energized coil 36. Consequently, it will be retained in the position to complete the circuits as described until the coil 36 is de-energized. This occurs upon the further movement of the switch 10 during which period both phonographs are operating and sound is being received by both phonographs. Both cylinders will thus record the sound during overlapping periods of operations of the phonographs. This will insure a continuance of the recordization of the sound.

The circuits through the speakers 3 and 4 are controlled in substantially the same manner as the circuits through the motors, whereby the speakers will continue to electrically receive the sound that is being transmitted to the apparatus through the lines 15 and 16. Upon the completion of the recordable area of the wax cylinder of the phonograph 2, the switch 10 is again shifted to open the circuit through the movable contacts 38 and 48 and thus break the circuit through the motor 8 and the coil 36. The circuit through the coil 51 is maintained due to the fact that the contact 48 remains closed after the contact 38 is open, but upon continued movement of the switch 10, and after a period of time sufficient to cause the switch 11 to operate by energization of the coil 51, the contact 48 is opened. The circuits, however, controlled by this operation of the switch 11 will be closed. This places the switch 11 in position for the operation of the switch 9 at a point near the completion of the recording on the cylinder of the phonograph 1. When the switch 11 has been operated, the wax cylinder of the phonograph 2 may be removed and replaced by another cylinder and the carriage of the phonograph 2 may be placed in its initial position preparatory to its re-operation with the substituted cylinder. When the carriage is shifted, the switch 10 will return to its normal position and the movable contact 48 will be open and the contact 38 will be closed. This may be done during the period of the operation of the phonograph 1. This gives opportunity for the placement of the cylinders in succession on the phonographs as they are being filled during the recording of the sound.

The circuit of the motor 7 is maintained from the line 46 through the line 60, movable contact 61, line 62, line 50, coil 51, line 52, movable contact 53, line 54, line 39 to the main line 22 after the switch 10 is returned to its normal position by the return movement of the carriage of the phonograph 2. The motor 7 continues to operate until the carriage of the phonograph 1 moves to near the completion of its outward movement when the carriage operates to shift the switch 9 to close the movable contact 63 while maintaining the contact 53 closed and finally to open the movable contact 53 during the time that the movable contact 63 is maintained closed. When the movable contact 63 is closed, the circuit from the main line 21 through the line 30, the motor 8, line 31, movable contact 63, line 35, coil 36, line 37, movable contact 38, line 39 to the return line 22 is completed. This initiates the operation of the phonograph 2 while the phonograph 1 is still recording the sound. Thus the sound for a short interim is recorded on both phonographs, on one at the beginning of the recordable surface of the cylinder, and on the other at the end of the recordable surface of the cylinder, to again produce overlapping periods of recordization. Upon further movement of the carriage, that is, substantially at the completion of the operation of the phonograph 1, the switch 9 is further moved to open the contact 53 which de-energizes the coil 51. The coil 36, being still energized by the circuit through the movable contact 63, causes the switch 11 to again operate and restore it to its original position. Opening of

the circuit 53 also opens the circuit through the motor 7 and the phonograph 1 stops. During the continuance of the operation of the phonograph 2, the carriage of the phonograph 1 may be re-set and the cut cylinder replaced with a new cylinder. Upon the completion of the cutting of the surface of the cylinder on the phonograph 2, the system will again initiate recording the sound on the substituted cylinder. Thus the apparatus will continue to record the sound received by the microphone 17 transmitted to the apparatus through the lines 15 and 16.

During the time that the phonograph 2 is being operated by the motor 8, the sound electrically transmitted through the wires 15 and 16 are directed to the loud speaker 4 and, during the period that the phonograph 1 is being operated, the sound is electrically transmitted to the speaker 3. The switching of the connection between the lines 15 and 16 to each of the speakers 3 and 4 is obtained through the contacts of the switches 9 and 10 in substantially the same manner that the motors 7 and 8 are controlled by the contacts 53 and 63 in the one case, and 38 and 40 in the other case. The contacts of the switches 9 and 10 are, therefore, duplicated in order to produce the operations of the speakers 3 and 4 in accordance to the operation of the motors 7 and 8 of the phonographs. Thus the speaker 4 is operated through the line 65 which is connected to a line 15 and to the speaker 4. The circuit is completed through the lines 66, to the movable contact 67, the lines 68, 69, through the movable contact 70, line 71 and to the line 60. Thus the circuit of the speaker 4 is dependent upon the position of the switches 10 and 11 in the same manner that the motor 8 is dependent upon the switches 10 and 11. The movable contacts 38 and 37 are similar in form and operate in the same manner with reference to their fixed contacts. The same is true with respect to the contacts 33 and 67. During the period that both coils 36 and 51 are energized, the contact 67 is maintained closed which is during the period that the speaker 3 is operating with the speaker 4. During this period the circuit is from the line 15 through the line 73, the speaker 3, line 74, through the movable contact 75, line 76, line 77, movable contact 78, line 79 to line 16. The movable contact 75, in conjunction with its fixed contacts, operates in the same manner as the movable contact 48 in conjunction with its contacts. Upon the completion of the movement of the carriage of the phonograph 2, the switch 10 is completely opened, the phonograph 1, however, continues to record the sound received through the speaker 3. In advance of the completion of the recording of the cylinder of the phonograph 1, the carriage of the phonograph 2 may be shifted to its initial position which restores the switch 10, and, consequently, the movable contact 70 completes its circuit preparatory to a later operation of the phonograph 2. At the same time the contact 75 breaks the circuit preparatory to the operation of the carriage of the phonograph 2 upon the completion of the recordization of the sound on the cylinder of the phonograph 1. When the circuit through the coil 36 has been broken and the switch 11 operates by reason of the energization of the coil 51, the movable contact 81 completes the circuit from the speaker 3 through the line 74, to the line 82, the line 77, through the movable contact 78, the line 79 and to the line 16, whereby the partial operation of the switch 9, which occurs at near the completion of the operation of the cylinder of the phonograph 1, will not effect the continuance of the operation of the phonograph 1. When the switch 9 is further operated at the completion of the movement of the carriage of the phonograph 1, the movable contact 85 completes the circuit from the line 15 through the line 65, the speaker 4, the line 66, the movable contact 85, the line 69, the movable contact 70, the line 71 to the line 16. Upon completion of the movement of the carriage of the phonograph 1, the movable contacts 53 and 78 will be opened breaking the circuit through the motor 7 and through the loud speaker 3, respectively.

When it is desired to reproduce the recorded sound, it may be done from the phonograph records or cylinders direct, but, preferably, it is done through a speaker which will deliver the sound with sufficient intensity that it may be heard throughout the room. This is particularly advantageous when the record is to be reproduced as for the benefit of a court. For the amplification of the sound produced by the record for its reproduction in considerable volume, the same system may be used, the phonographs operating to continuously reproduce the sound recorded on the plurality of cylinders which are subsequently placed upon the phonographs and in alternate order in the same manner that the sound was recorded, as described above. The carriages of the phonographs will operate to switch the motor circuits in the same way that they operated during the recording of the sound, as described above, to direct the sound recorded on the cylinders to microphones connected in parallel which may be amplified by the amplifiers used in recording the sound, the amplified electrically reproduced sound being delivered to the loud speaker.

The circuits of Fig. 2 are the same as those shown in Fig. 1 except that the unused lines are shown as being disconnected, in order to simplify the diagram, as shown in Fig. 2. The phonographs 1 and 2 are operated by the motors 7 and 8 which are connected through the movable contacts 53 and 38 of the switches 9 and 10, that are operated by

the carriages of the phonographs, as described above. The movable contacts 38 and 53, with their fixed contacts, coact to control the switch 11 in the same manner that the switch 11 is operated when the sound is recorded and, in conjunction with the movable contacts 63 and 48, operate to connect the coils 51 and 36 in the circuit in succession. The de-energization of one of the coils 36 or 51 permit the other of the said coils to throw the switch 11 to move the movable contacts 33 and 61 which enables the restoration of one or the other of the switches 9 and 10 by the replacement of the carriage of the associated phonograph in its initial position as in recording the sound. This gives opportunity for placement of a succeeding cylinder having a portion of the recorded sound. Thus, in the reproduction of the sound, the same steps are followed through the circuits as set forth in the description of the recording of the sound.

The switch 90, which controls the connection between the microphone 17 and the transmission amplifier 18, is opened and moved to connect the transmission amplifier with the microphones 91 and 92 that are connected in parallel, and the switch 20 is moved to shift its connection from the speakers 3 and 4 through the lines 15 and 16 so as to connect the receiving amplifier 19 with the loud speaker 94. Thus, the sound produced by the phonographs will be translated into electric sound currents or vibrations by means of the microphones 91 and 92 located in sound receiving relation to the phonographs. When one or the other of the phonographs 1 and 2 move, the carriages of the phonographs from the initial to the finishing positions of the cylinders, there will be short overlapping periods of such transfer, wherein the same sound will be produced by both phonographs, namely, at the points shortly in advance of the completion of the reproduction of the sound from one of the phonographs and subsequent to the starting of the other of the phonographs and for a short period after starting of the last named phonograph. There will thus be produced a continuous uninterrupted reproduction of the sound that has been recorded on the cylinders that are placed sequentially upon the phonographs. Confusion of the sound produced during the periods when both phonographs are delivering sound to the electric speaking circuits, of the loud speaker 94, is obviated by reason of the fact that the motor of the phonograph that is to be operated during the succeeding period is started by the other phonograph when it reaches the same point at which movement of the cylinder was initiated during the recording of the sound. If the succeeding cylinder is located at a point displaced with reference to the record of the other cylinder, it may be easily turned or the carriage moved to produce the same sound in the loud speaker from the two cylinders by an attendant. If desired megaphones 95 and 96 may be located on the tubes 5 and 6 for directing the sound to the microphones 91 and 92.

The switches 9 and 10 may be supported on the frame 100 of the phonograph. As shown in Figs. 3 to 6, the contacts of the switches are, preferably, elastic contacts to permit movement of the contacts in pairs where it is found desirable to maintain the contacts closed during overlapping periods such as between the movable contacts 53 and 78 and their associated contacts 101 and 102 of the switch 9 and the corresponding contacts of the switch 10. The contacts 63 and 85 operate to complete their circuits, as described above, through their coacting and associated contacts 103 and 104. The contacts are operated by means of the rollers 106 and 107, each roller being associated with each pair of contacts and so as to operate one of the contacts to separate or open the circuits through the contacts with which each roller is associated. The switch 9 is operated by means of a cam 108 which may be made in the form of a bar having a sloping surface 109. The cam 108 is connected to the carriage 110. Consequently, the switch 9 will be operated to control the motor circuit of the other phonograph as well as to operate the switch lever and also to control the electric speaking circuit during the reproduction of the sound.

The strips that form the contacts are suitably bound together between insulating strips 111 and secured to a bracket 112 by suitable bolts 113, the bracket 112 being mounted on the frame 100 of the phonograph. The rollers 106 and 107 are supported on arms that depend from the contacts to which they are connected, and the cam 108 operates to lift the rollers. When the cam 108 is removed from beneath the rollers, the contacts, in one case, are closed and, in the other case, are open, as described in connection with the system shown in Fig. 1.

The switch 10 of the phonograph 2 is constructed in the same manner that the switch 9 of the phonograph 2 is constructed. In order to eliminate metallic sounds and insure clear recordization and reproduction of the sounds, tubes 5 and 6, of relatively considerable length, are used. It has been found that the long tubes 5 and 6 give opportunity for elastic movement of the diaphragms and eliminate chattering or metallic sounds. This has been found to be a great improvement over transmission of sounds to and from the recording cylinders. The tubes are substantially 4 or 5 inches long to produce more efficient results. Also, to further eliminate metallic sounds, the tubes are formed of fiber

as distinct from glass or metal, such as bakelite, fiber board, or the like.

In order that the transmission of sound to the recorder may be ascertained by an attendant, the ear phones 115, which are connected to a bifurcated flexible tube 116, are connected to the tubes 5 and 6. To prevent undue ear shock, the tubes 5 and 6 are provided with openings about $\frac{3}{16}$ inch in diameter, that are, preferably, located directly opposite the point of connection of the bifurcated ends of the flexible tube 116 with the tubes 5 and 6. Thus, as shown in Fig. 7, the tube 5 is provided with an opening 114 which is preferably located opposite the point of connection of the tube 116 with the interior of the tube 5.

Also, by the use of the ear phones, the loudness of the speech that is being received by each of the phonographs can be determined and adjustment made accordingly in order that the reproduced speech, during the reproduction from the succeeding cylinders, will be substantially constant in volume. Also, in reproduction, the ear phones will insure that correct placement is made by the attendant by the sound produced during the overlapping periods of reproduction from both cylinders.

I claim:

1. In a sound recording and reproducing system in combination with amplifying speaking circuit, a pair of phonographs, a source of supply of electric current for operating the motors of the phonographs, a pair of switches operated by the said phonographs, the switch operated by one phonograph for controlling the motor of the other phonograph to complete the circuit of the motor of the other phonograph, a second switch having fixed contacts in circuits in parallel to the contacts of the first named switches, means for operating the second named switch for completing circuits that by-pass the said first named switches, and means for causing the operation of the second named switches subsequent to the operations of the first named switches to permit opening of the first named switches and to alternately connect the phonographs to the amplifying speaking circuit.

2. In a sound recording and reproducing means, a phonograph, an electric receiver, a fiber tube located in sound transmission relation to the phonographic diaphragm of the phonograph, a tube, an ear phone connected to the tube at one end, the other end of the ear phone connected to the first named tube, the first named tube having an opening in proximity to the connection of the second named tube to the first named tube.

3. In a sound recording and reproducing means, a phonograph, an electric receiver, a fiber tube located in sound transmission relation to the phonographic diaphragm of the phonograph, a fiber tube, an ear phone connected to the tube at one end, the other end of the ear phone connected to the first named tube, the first named tube having an opening in proximity to the connection of the second named tube to the first named tube.

4. In a sound recording apparatus, a pair of phonographs, a pair of electric speakers, a pair of tubes for connecting the speakers to the phonographs, a flexible tube, an ear phone connected to one end of the flexible tube, the flexible tube connected to the first named tubes, the first named tubes having openings in proximity to the points of connection of the second named tube with the first named tubes.

5. In a sound recording system in combination with an amplifying speaking circuit, a pair of phonographs, a source of supply of electric current for operating the motors of the phonographs to record sound received from the amplifying speaking circuit, two pairs of switches operated by each phonograph in succession, the circuits of both phonographs controlled by the said two pairs of switches, and an electromagnetic switch having contacts in circuits in parallel to the contacts of the first named switches, the contacts of the electromagnetic switch divided into two sets, the electromagnetic switch having a pair of magnets for operating their associated switches to complete the circuits of the sets of contacts alternately that by-pass the contacts of the said first named switches, the circuits of the said magnets controlled by the first named switches, and means operable to open the circuits of the magnets alternately and subsequent to the completion of the circuit of one of the phonographs by one of the first named switches to produce operation of the electromagnetic switch after the completion of the circuit of one of the phonographs to alternately connect the phonographs with the amplifying circuit.

In witness whereof I have hereunto signed my name to this specification.

JAY C. SNYDER.