

June 25, 1963

D. J. LESLIE
SYSTEM FOR RECORDING AND REPRODUCING
ELECTRIC ORGAN MUSIC

3,095,477

Filed Jan. 12, 1959

4 Sheets-Sheet 1

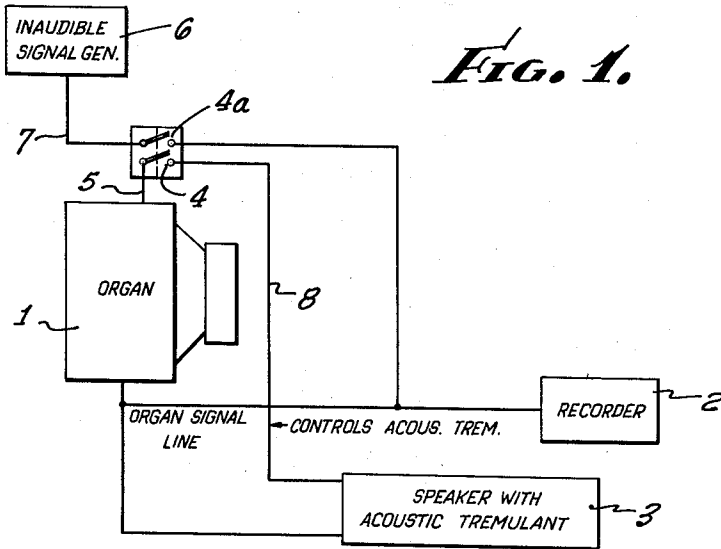


FIG. 1.

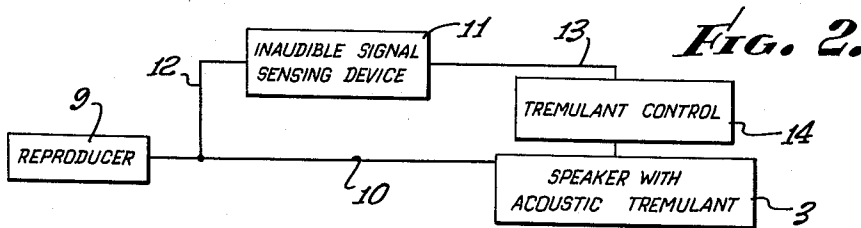


FIG. 2.

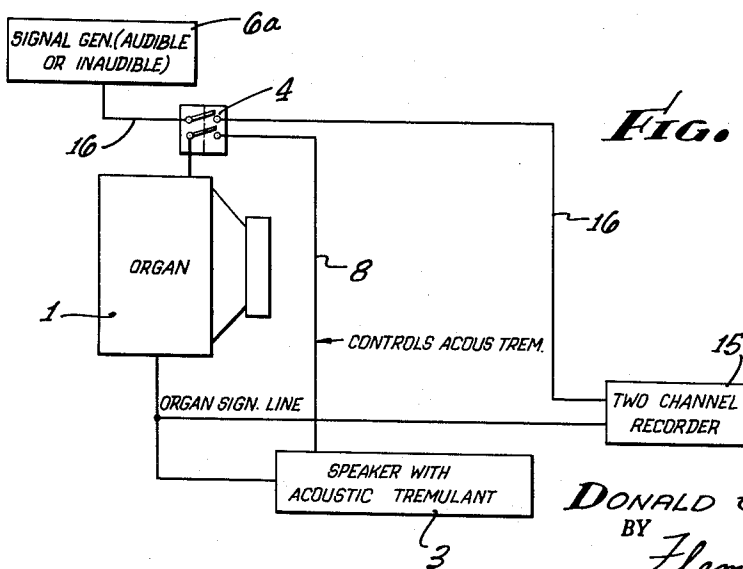


FIG. 3.

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FIG. 4.

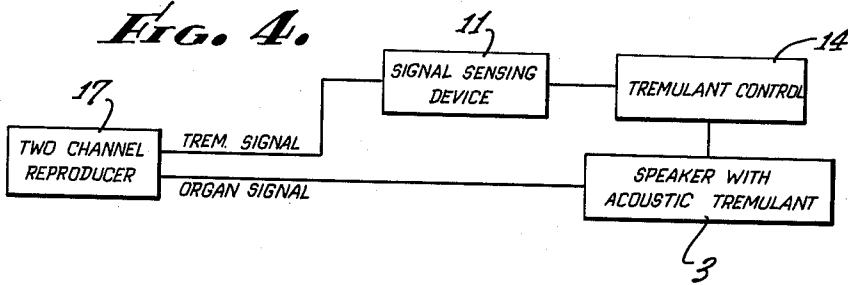


FIG. 5.

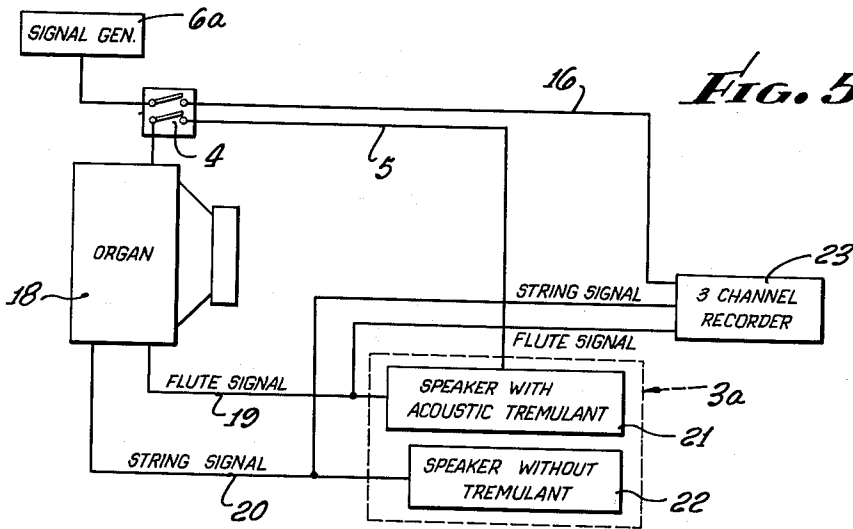
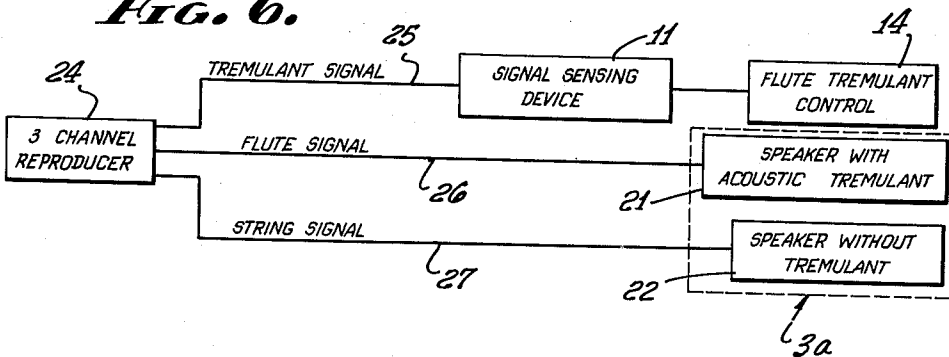


FIG. 6.



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Fig. 7.

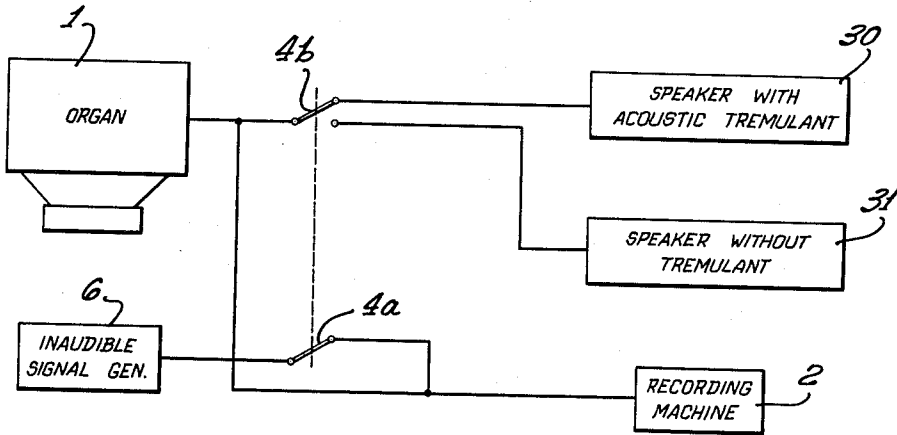
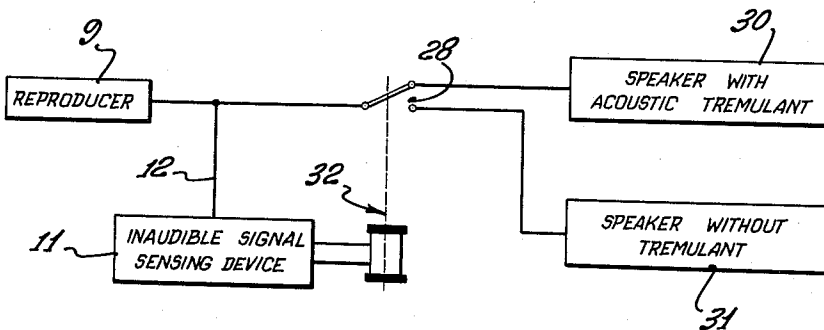


Fig. 8.



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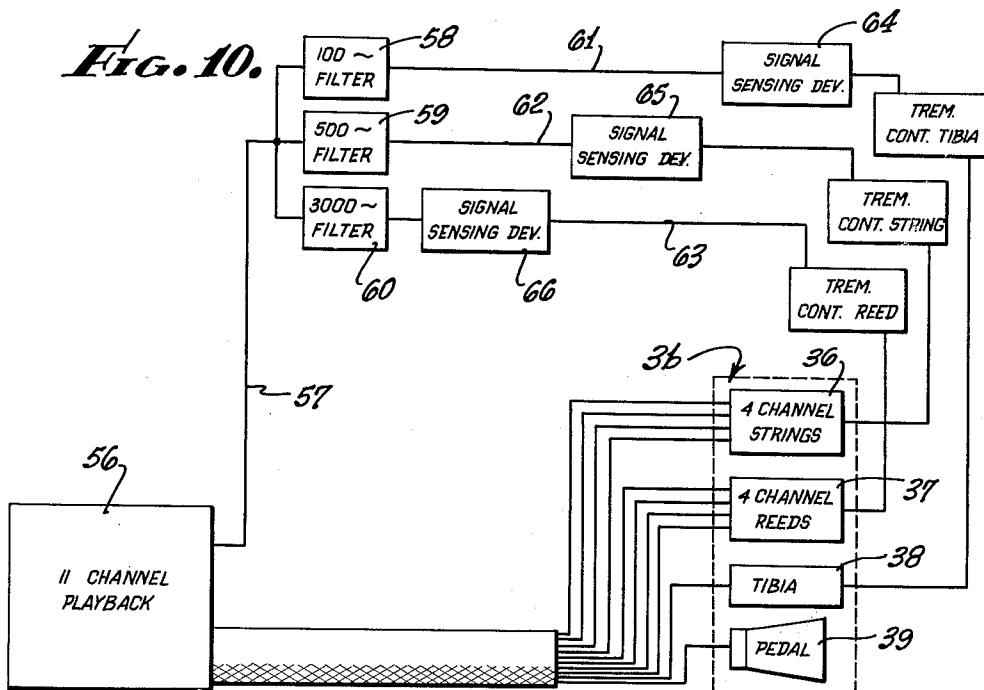
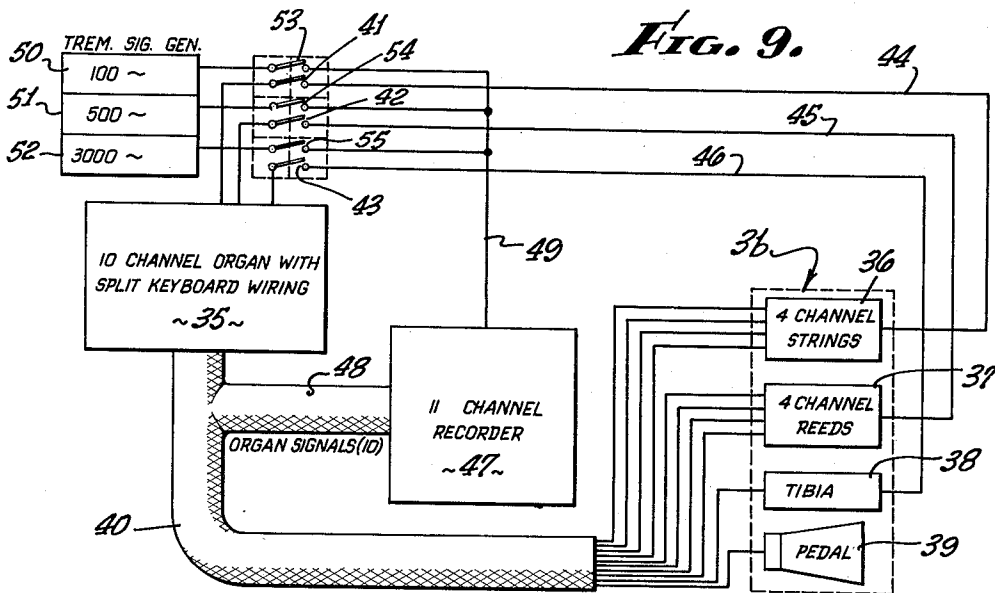
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3,095,477
**SYSTEM FOR RECORDING AND REPRODUCING
 ELECTRIC ORGAN MUSIC**

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 Filed Jan. 12, 1959, Ser. No. 786,151
 15 Claims. (Cl. 179—1)

This invention relates to a system for recording and reproducing music played on an electric organ.

In order that music of this character be pleasing to the ear, it has been common to produce a vibrato or pitch tremolo therewith. This tremolo is effective when the pitch of any note is alternately raised and lowered about six or eight times a second.

When a record is made of such organ music in which pitch tremolo is present, a mere playing of the record does not properly simulate the "greatness" of organ music.

It is one of the objects of this invention to make it possible to record and reproduce organ music in such manner that the illusion of original organ music is preserved, and pitch tremolo effects created. By recording the electrical impulses directly from the electric or electronic organ console before they are released as sound, the original wave forms are preserved without any acoustical effects or limitations being imposed. The record thus made is of a straight character that is not generally useful when played through ordinary sound systems. Since an acoustic tremulant, such as a rotating horn-type speaker system, imparts perspective and realism, the benefit of this treatment is applied at the time the record is played; and if the recording is carefully made without distortion or noise, it becomes impossible to distinguish whether the selection is being played by an organist or whether a record is being used as the source of music. In effect, the electrical impulses that represent the music are intercepted and merely delayed before they become sound, and as no microphones are used in the system, the usual acoustical problems are not present; for instance, a famous organist could make a special recording of the character described, and this recording could be played at a distant point, the results being the same as though the organist were actually playing an organ at the said distant point.

Normally the acoustic tremulant (for reality) is controlled by an on-off switch on the organ console, whereby the rotary horn speaker is at times operative, and at other times inoperative, depending upon the desired interpretive effects. Another object of this invention is to incorporate signal means whereby on-off operation of the rotary horn speaker is faithfully reproduced.

In some organ systems, acoustic tremulant is added separately to different tones. For example, tremulant may separately be controlled, as by different tabs, for string tones, reed tones, etc. This is provided, in essence, by a plurality of separate electrical-acoustic channels. Other organ systems may incorporate numerous electrical-acoustic channels for reasons other than acoustic tremulant. An object of this invention is to provide a simple system for faithfully recording and reproducing multiple-channel organ music.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several embodiments of the invention. For this purpose, there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURES 1 and 2 are diagrammatic views illustrating, respectively, recording and reproducing apparatus in accordance with one form of the present invention;

FIGS. 3 and 4 are diagrammatic views illustrating, respectively, recording and reproducing apparatus in accordance with a second form of the present invention;

FIGS. 5 and 6 are diagrammatic views illustrating, respectively, recording and reproducing apparatus in accordance with a third form of the present invention;

FIGS. 7 and 8 are diagrammatic views illustrating, respectively, recording and reproducing apparatus in accordance with a fourth form of the present invention; and

FIGS. 9 and 10 are diagrammatic views illustrating, respectively, recording and reproducing apparatus in accordance with a fifth form of the present invention.

In reproducing recorded electronic organ music, a sensation of realism or actual presence of the artist is created by the use of a speaker that is substantially identical to the one normally used with the organ in question. But many such speaker structures incorporate movable devices for adding tremolo acoustically. The tremolo can be recorded by using a microphone; but a sensation of presence cannot be created in this manner. Instead, the movable devices of the speaker must reproduce the operations occurring during recording if realism is to be created. Thus, the organ speaker used for reproduction must be actuated in the identical manner that it would have been if the organist were present. The speaker structure is actuated in two distinct ways: first of all, electrical impulses corresponding to sound are applied to transducers; secondly, signals or energization are applied to apparatus that operates the acoustic tremulant apparatus.

The electrical impulses corresponding to sound can, of course, be directly recorded and used later to drive transducers of the speaker structure. The recording of impulses is done directly so that no acoustic qualities prematurely modify the impulses. The on-off control or energization of the physically rotating acoustic tremulant apparatus can also be recorded, at least in a form appropriate for recording.

FIGS. 1 and 2 diagrammatize an elementary system for accomplishing the foregoing result. The organ console 1 has an output connected both to a recorder 2 and a monitoring speaker 3. The monitoring speaker 3 includes apparatus for producing tremulant acoustically, as by rotation of a sound channel. It is preferably identical to a speaker to be used in reproduction. The recorder 2 makes a record of the impulses produced by organ 1 and applied to the monitoring speaker 3 and not what the speaker 3 produces.

The organist also controls the periods of operation of the acoustic tremulant apparatus incorporated in the speaker structure 3. A switch 4, usually attached at the organ console 1, serves as a means for controlling the tremulant. A control line 5 extends to the speaker; the line 5 may carry a control impulse, as for example to a power relay, or it may carry the energization current for the apparatus. The switch 4 is manipulated in accordance with the interpretive effects intended to be provided by the organist.

In order to make use of the single recording channel of the recorder 2 for purposes of recording both the musical actuation and the tremulant actuation, an inaudible signal generator 6 is used which, for example, produces a signal beyond the range of audibility. This generator provides an output signal applied to the recorder 2 whenever the tremolo switch 4 is in one of its two positions. For this purpose, a switch 4a between the generator 6 and the recorder 2 is provided that is closed whenever the tremolo switch 4 is closed, and opened whenever the

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tremolo switch 4 is opened. A lead 7 extends from the signal generator 6 to the switch 4a, and a lead 8 extends from the switch 4a to the recorder 2. The signal recorded, since it is inaudible, does not interfere with the signals corresponding to musical tones.

In FIG. 2 there is illustrated a reproducing system operated by the record produced as previously described. The reproducer 9 has an output indicated by a connection 10 directly driving the electrical-acoustic transducers of the speaker structure 3. Furthermore, a device 11, by the aid of a connection 12 to the output of the reproducer 9, senses the existence or non-existence of the inaudible signal or, in essence, whether acoustic tremulant is intended or not. The sensing device 11 has an output 13 which operates a control 14 which, in turn, drives or controls the speaker structure 3 in precisely the same manner that the speaker 3 is normally controlled by the tremolo switch 4.

Accordingly, the speaker 3, when used for reproduction, is actuated in precisely the same manner as if an organ console instead of the reproducer 9 were used. It is impossible to tell by ear that an organist is not present.

In the form illustrated in FIGS. 3 and 4, identical parts are provided with similar reference characters. In the present instance, a recorder 15 is provided that has two separate recording channels. The recorder may be of the magnetic tape type having two heads cooperable with spaced bands of the tape. The signal corresponding to the existence and non-existence of acoustic tremulant is recorded on a separate channel. Hence, the signal need not be in the inaudible range since it is isolated in its own recording channel. In this instance, the tremolo switch 4 controls a signal generator 6a in essentially the same manner as in the previous form. A lead 16, however, from the signal generator 6a and controlled by the tremolo switch 4 is applied to a separate channel in the recorder 15.

In FIG. 4 a reproducer 17 has, of course, two output channels. One of them, which corresponds to the tremolo on-off signal, is applied to the sensing device 11, and by the aid of the control device 14, the acoustic tremulant of the speaker 3 is appropriately provided. The other output from the reproducer 17 is applied directly to the transducers of speaker structure 3, and it, of course, carries the signals corresponding to musical tones.

In the form illustrated in FIG. 5, an organ console 18 provides two separate electrical outputs indicated by the leads 19 and 20. Separate transducer structures 21 and 22 of a speaker 3a are driven by the respective outputs 19 and 20. Acoustic tremulant is added only to the musical tones produced by the transducer 21, the control lead 5 extending only to this transducer.

The segregation of output impulses for selective application of acoustic tremolo is described, for example, in my copending application Serial No. 590,629, filed June 11, 1956, now abandoned, and entitled Speaker System for Adding Tremolo. A tremolo switch 4, identical to the previous switch, has a control lead 5 which controls only the speaker structure 21. Associated with the tremolo switch is the signal generator 6a. The speaker 3a is actuated in three manners: first, by an output at 19 from the organ console 1 in which acoustic tremulant may be added; second, by an output at 20 in which tremulant is in this example never added; and third, by control lead 5 for operating the acoustic tremulant. To accommodate this information, a three-channel recorder 23 is utilized. The signal generator 6a may be in the audible range. Accordingly, it is applied to one of the three channels of the recorder 23. The outputs from the connections 19 and 20 are respectively applied to the remaining channels of the three-channel recorder 23.

For purposes of reproduction and as illustrated in FIG. 6, a three-channel reproducer 24 is provided. One output, as at 25, is applied to a signal sensing device 11. An output operating a control device 14 is provided so that

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tremulant is added at the appropriate time. The second output, as at the lead 26, is applied directly to the transducer 21; and the remaining output 27 is applied to the other transducer 22. In this instance as in the previous form, the entire speaker 3a is actuated in precisely the same manner as if by an organ console.

In FIGS. 7 and 8 an organ console 1, an inaudible signal generator 6 and a single-channel recorder 2 are illustrated. In the present example, the tremolo switch 4b merely switches the output from the organ console 1 between two speaker structures 30 and 31, one of which incorporates continuously operable devices for acoustically adding tremulant, and the other of which contains no acoustic apparatus at all. The switch 4a establishes a connection between the recording machine 2 and the inaudible signal generator 6 when the tremolo switch 4b is in one position, in this example in a position corresponding to application of acoustic tremulant. The signal from the console 1 is applied directly to the recorder 2.

The reproducing system in FIG. 8 for the recording system of FIG. 7 incorporates an inaudible signal sensing device 11. It is connected to the reproducer 9 by a lead 12. The sensing device 11 has an output which controls a relay 32. The relay, in turn, moves a switch 28 between alternate contacting positions. In one position the switch 28 transmits signals from the reproducer 9 to one of the speakers 30, and in the other position to the opposite speaker 31. Accordingly, the recording and reproducing system faithfully reproduces the organ music.

In FIGS. 9 and 10 there is illustrated a multiple-channel organ console 35. A speaker structure 3b includes four different speaker assemblies 36, 37, 38 and 39 labelled, respectively, "strings," "reeds," "tibia" and "pedal" by way of example, and cooperating with impulses corresponding to such tones.

The speaker assemblies 36, 37 and 38 may each incorporate rotary apparatus for acoustically adding tremulant to the sounds and in different manners appropriate to the tones reproduced by the speaker assemblies 36, 37 and 38. In the present example, the speaker assembly 36 incorporates four separate speakers, as does the speaker assembly 37. The assemblies 38 and 39 may contain one or more speakers in parallel. The impulses corresponding to different tones may be segregated among the channels for purposes of eliminating certain "beat effects" and as described, for example, in my copending application Serial No. 500,568, filed April 11, 1955, and entitled Electric Organ Speaker System.

The organ console 35 is illustrated as having a multiple-channel output cable 40, the conductors of which are appropriately connected to the speaker assemblies 36, 37, 38 and 39. Three separate tremolo switches 41, 42 and 43 are provided for the respective speakers assemblies 36, 37 and 38. By closing the switch 41, for example, tremulant is added acoustically to the string tones. The switches 41, 42 and 43 are manipulated by the organist in a manner deemed appropriate for interpretive effects.

The entire speaker structure 3b is, in this instance, actuated by thirteen channels of information. Thus, there are ten separate musical channels for actuation of the transducers, and there are three leads 44, 45 and 46 for controlling the apparatus for acoustically adding tremulant. This information is recorded in the present example by an eleven-channel recorder 47.

A cable 48 applies the signal from the ten musical channels to ten of the channels of the recorder 47. The eleventh channel of the recorder is used for the three tremulant controls. When the tremolo switch 41, for example, is operated, a signal of one characteristic frequency, say 100 cycles per second, is applied to this tremolo channel and by the aid of a lead 49. If, however, the tremolo switch 42 is operated, a second characteristic frequency is applied to the tremolo channel of the recorder 47, in this example 500 cycles per second.

Similarly, if the tremolo switch 43 is operated, a third characteristic frequency, as for example at 3000 cycles per second, is applied to the eleventh channel of the recorder 47 via the lead 49. This is accomplished by the provision of three signal generators 50, 51 and 52 and switches 53, 54 and 55 respectively associated with the tremolo switches 41, 42 and 43. The switches 53, 54 and 55 connect respectively to their signal generators 50, 51 and 52 and to the common lead 49.

For purposes of reproduction, a reproducer 56 (FIG. 10) is provided. The reproducer 56 of course has eleven output channels, ten of which are used to transmit signals to the ten channels of the speaker 3b. The other channel has an output lead 57 which is split by band-pass filters 58, 59 and 60 to three leads 61, 62 and 63. If a signal of 100 cycles per second exists at the output lead 57, it is passed only to the lead 61. Similarly, if a signal of 500 cycles per second exists, it is passed only to the lead 62. And if a signal of 3000 cycles per second is present, it is passed only to the lead 63.

Sensing devices 64, 65 and 66 respectively appropriately control the speaker assemblies 36, 37 and 38 of the speaker structure 3b, the devices cooperating with the respective leads 61, 62 and 63. Whatever acoustic tremulant is used by the organist is faithfully reproduced by the system described herein.

The inventor claims:

1. The process of recording the music of an electronic instrument which produces sound only by the aid of a speaker system including acoustic apparatus for imparting tremulant, which comprises: producing, by the aid of the instrument, electrical impulses corresponding to musical tones that are free of acoustic effects, and independently of the production of audible sound; intercepting the impulses so produced at a stage in advance of the speaker system and recording the impulses on a record; controlling the operation of the acoustic apparatus; producing a signal in accordance with the operation of said acoustic apparatus; and recording the signal on said record.

2. The process of reproducing the music of an electronic instrument which produces sound only by the aid of a speaker system including acoustic apparatus for imparting tremulant, which comprises: reproducing by the aid of a reproducer and a record, impulses produced by the instrument corresponding to musical tones, which impulses are free of acoustic effects, the said impulses having been produced independently of the production of audible sound, and upon which record is also recorded a signal corresponding to the operation or non-operation of said acoustic apparatus; applying the impulses to a speaker having acoustic apparatus for imparting tremulant; and controlling the acoustic apparatus by the aid of said signal.

3. In apparatus for recording music by the aid of electrical impulses generated by an electronic organ having acoustic apparatus for adding tremulant, and having switch means for changing the mode of operation of said acoustic apparatus in accordance with the desires of the organist, the combination with said switch means of: a recorder connected to the organ for receiving and recording said impulses free of acoustical effects; and means operatively associated with said switch means for applying signal impulses to the recorder for recording thereby in accordance with a change in the mode of operation of said apparatus whereby said signal impulses may later be detected in conjunction with reproducing means, to control acoustic apparatus for imparting tremulant thereby to recreate the entire output of the organ.

4. In apparatus for reproducing music of an electronic organ having acoustic apparatus for adding tremulant: a record of musical impulses devoid of acoustical effects, and of signal impulses corresponding to a change in operation of said apparatus; a reproducer having acoustic apparatus for adding tremulant; means cooperable with the record

for causing operation of the acoustic apparatus of the reproducer in accordance with said signal impulses of said record; and means cooperable with the record for applying said musical impulses of said record to said reproducer.

5. The process of recording the music of an electronic instrument which produces sound only by the aid of a speaker system including acoustic apparatus for imparting tremulant, which comprises: producing, by the aid of the instrument, electrical impulses corresponding to musical tones that are free of acoustic effects, and independently of the production of audible sound; intercepting the impulses so produced at a stage in advance of the speaker system and recording the impulses on a record; controlling the operation of the acoustic apparatus; producing an inaudible signal in accordance with the operation of said acoustic apparatus; and recording said signal on said record in a channel common at least to some of said impulses.

6. The process of recording the music of an electronic instrument which produces sound only by the aid of a speaker system including acoustic apparatus for imparting tremulant, which comprises: producing, by the aid of the instrument, electrical impulses corresponding to musical tones that are free of acoustic effects, and independently of the production of audible sound; intercepting the impulses so produced at a stage in advance of the speaker system and recording the impulses on one channel of a two-channel record; controlling the operation of the acoustic apparatus; producing a signal in accordance with the operation of said acoustic apparatus; and recording the signal on the other channel of said record.

7. The process of recording the music of an electronic organ having a plurality of separate electrical outputs, and a corresponding plurality of electrical-acoustic channels with at least one of which there is provided means for adding tremulant acoustically, which comprises recording on a multiple-channel record the electrical impulses produced at said outputs respectively and prior to their translation into sound; and recording on said record a signal indicative of the operation of a corresponding acoustic tremulant apparatus.

8. The process of reproducing the music of an electronic organ having a plurality of separate outputs for electrical-acoustic channels with at least one of which there is provided means for adding tremulant acoustically, which comprises: producing, by a multiple-channel reproducer and a record, a plurality of separate electrical outputs corresponding to the outputs of said organ prior to their translation into sound; transmitting said outputs respectively to separate electrical-acoustic channels of a speaker system having means for adding tremulant acoustically in cooperation with at least one of the channels; sensing a signal recorded on said record which is indicative of desired operation of said means; and controlling said means in accordance with said signal and by the aid of said sensing means.

9. The process of recording music of an electronic organ having a pair of transducers, one of which incorporates means for acoustically adding tremulant, which comprises: selectively switching the output of the organ between said transducers; recording on a record the output of said organ before its translation into sound; and recording on said record a signal corresponding to the switching of the output between said transducers.

10. The process of reproducing music of an electronic organ from a record that includes impulses produced by the organ prior to the translation of said impulses into sound and a signal corresponding to the switching of organ output between transducers, one of which incorporates means for acoustically adding tremulant, which comprises: producing an output from said record by the aid of a reproducer; detecting said signal from said output; and switching the output between two transducers in accordance with said signal, one of the transducers incorporating means for acoustically adding tremulant.

11. The process of recording the music of an electronic organ having a plurality of separate electrical outputs, a

corresponding plurality of electrical-acoustic channels, and a plurality of separate means for adding tremulant acoustically in cooperation with at least some of the channels, which comprises: recording on a multiple-channel record the electrical impulses produced at said outputs prior to their translation into sound; generating significantly different signals corresponding to the number of said means; and transmitting said signals to a channel of said record for recording in accordance with the operation of said separate means.

12. The process of reproducing the music of an electronic organ having a plurality of separate outputs for electrical-acoustic channels and a plurality of separate means for adding tremulant acoustically in cooperation with some of the channels, which comprises: producing by a multiple-channel reproducer, a plurality of separate electrical outputs; connecting said outputs respectively to separate electrical-acoustic channels of a speaker system having a plurality of separate means for adding tremulant acoustically in cooperation with some of the channels; deriving recorded significantly different signals indicative of the operation of said means; and respectively controlling said means in accordance with said signals and by the aid of sensing means responsive to said signals.

13. For use in recording the music of an electronic organ having means for producing tremulant acoustically: a signal generator; a selectively movable controller for controlling said means; and a switch coupled to said controller for correspondingly controlling said signal generator.

14. For use in recording the music of an electronic organ having a plurality of means for producing tremulant

acoustically: a selectively movable controller for each of said means; a signal generator for each of said means; and a switch coupled to each controller for correspondingly controlling said signal generators.

15. The process of recording and re-creating the music of an electronic instrument which produces sound only by the aid of a speaker system including acoustic apparatus for imparting tremulant, which comprises: producing, by the aid of the instrument, electrical impulses corresponding to musical tones that are free of acoustic effects, and independently of the production of audible sound; intercepting the impulses so produced at a stage in advance of the speaker system and recording the impulses on a record; reproducing the recorded impulses; and driving a speaker system including acoustic apparatus for imparting tremulant, by the aid of the impulses reproduced whereby the entire output of the instrument is realistically re-created.

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