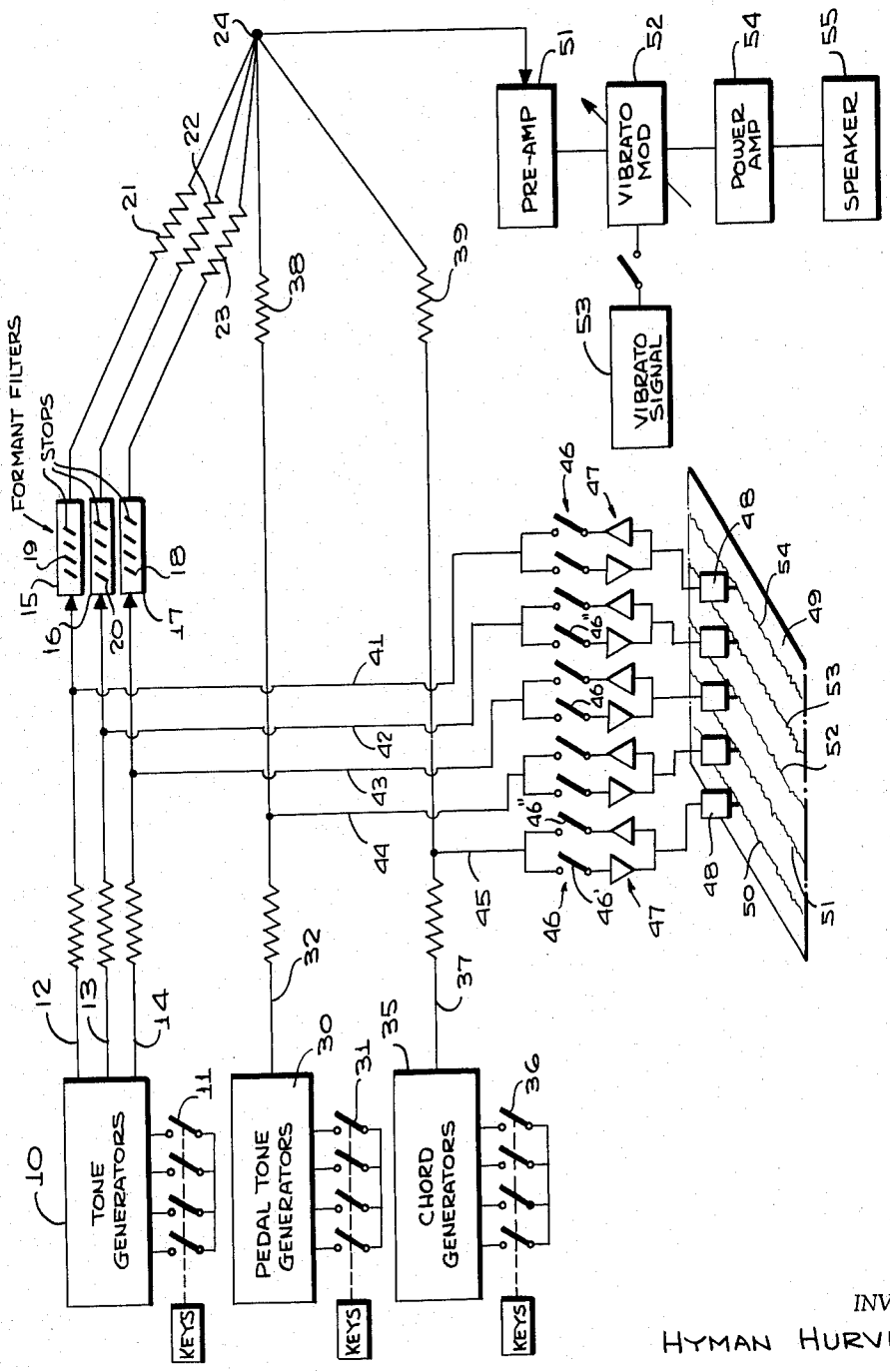
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TEACHING DEVICE

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TEACHING DEVICE

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The present invention relates generally to electrical musical instruments of the automatic player type, and more particularly to systems for automatically playing musical selections by means of electronic organs of the type employing key-controlled tone generators for generating harmonic-rich tones and formant filters for translating the harmonic-rich tones to tones simulating conventional musical tones.

Many conventional and commercial electronic organs comprise a plurality of tone generators which are energized selectively by manually actuable keys and in consequence provide a series of tonal combinations in the form of electrical signals, each consisting of a harmonic-rich ensemble of frequencies. As generated, the harmonics for each tone are of predetermined amplitudes. By suitable manipulation of the keys musical compositions may be played, and these may be acoustically translated by conventional devices. The tones as generated by the tone generators do not simulate true pipe organ tones, nor the tones of other conventional musical instruments, in their harmonic content. To attain the latter result the tones are passed through selected formant or tone color filters, which change the harmonic content of the tones generated by the generators in such a fashion as to cause the tones delivered by the formant filters to simulate the frequency content of conventional musical instruments or of pipe organ tones. The tonal output of the formant filters is amplified at will, subjected to vibrato modulation, and electro-acoustically transduced.

According to the present invention the raw tones provided by the tone generators are recorded on magnetic tape or on discs, or in any other conventional fashion, while a musical selection is being played on the organ. The recording then lacks the tone modifying effect of the formant filters, and of gain control in the amplifier, i.e., is composed of uniform amplitude tone signals of maximum harmonic content for the tone generators involved, regardless of the expression or stops which the musician may be employing as he plays the selection.

The recorded signals are then reproduced at some time following the original recording of the musical composition, and the reproduced tones inserted at the input of the formant filters. A player may then select his own stops and expression, at will, whereby he may re-render the originally recorded composition quite distinguishably from its form as originally rendered, and the variation may be modified further on each successive reproduced rendition, to suit the taste of the player, or to suit the occasion. It will be clear that the player who is rendering a reproduced rendition need not be an organist, but may be musically unskilled.

A simplified system of the above described type, such as is shown in U.S. Patent No. 3,011,378, issued to the present inventor, has limitations in respect to utility, in that the usual electronic organ possesses multiple keyboards or divisions, separate provision for generating chords, and various sets of formant filters, and provision must be made for accommodating these. Additionally, it may be desired, for purpose of musical instruction, to reproduce the melody only, or the accompaniment only, of a musical selection, adding the other manually. To this end, according to the present invention, a multiple track tape recorder is employed, each track being employed for recording and/or reproducing the output of only one tonal bus or division of the organ. These may

comprise right and left hand manuals, solo stops, pedal and chord generators. It then becomes possible to record the tempo and arrangement in raw or unfiltered tones appropriate to a musical selection, completely, but in a plurality of distinct tracks, so that reproduction may take place, for example, at will, of the chords alone, the left hand or right hand manual alone, the 8′ or 4′ buses, the pedal, et cetera, according to the complexity of the organ involved. The remainder of any piece of music can then be added as accompaniment by the performer. For example, the recorder may play all of a selection, except the chords, affording the performer student practice in adding chords. Or, the recorder may supply chords and pedal, giving the student practice in adding melody.

Additionally, if the system is employed for musical enjoyment instead of instruction the several divisions of the organ can be separately treated in respect to tone colour, precisely as is the case when the organ is played manually.

It is, accordingly, a broad object of the present invention to provide a system of automatic rendition of organ music by an unskilled person, the notes being previously recorded without stop selection or expression, but separated by organ divisions, by a skilled musician, and the unskilled person contributing expression and stop selection to the rendition, or accompaniment on one division of music recorded from another division.

It is a further object of the invention to provide a simple, inexpensive automatic player system for electronic organs, applicable to conventional multi-division organs, with virtually no reorganization thereof, and in which tonal character and expression of automatically reproduced music may be controlled as to each organ division selectively and at will by the stops and expression pedal of the organ.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawing, wherein:

The single figure is a functional block diagram of a system according to the invention.

Referring now to the single figure of the drawings, the reference numeral **10** denotes a set or array of tone generators, which may be selected by one or several manuals, conventionally represented at **11**. These may be said to constitute separate organ divisions, as solo, swell, great, 4′, 8′, 16′ and the like, each of which proceeds over separate buses as **12, 13, 14**. The latter supply signal to separate banks of formant or tone colour filters, **15, 16, 17**, each of which has several stops as **18, 19, 20**. The formant filters proceed via individual isolating resistors **21, 22, 23** to a common terminal **24**.

Similarly, a set or array of pedal tone generator **30** is provided, having pedal switches **31**, which provides pedal tones via a bus **32** to the terminal **24**.

In addition, a chord generator system **35** may be provided, having chord selection switches **36**. The output of system **35** proceeds via bus **37** to terminal **24**. Isolating resistances **38, 39** are provided in buses **32, 37** to isolate or reduce feed-through from one bus to another, and for similar reasons protective resistances **40** are connected adjacent the tone generators. It is feasible and in some ways desirable to effect such isolation by means of amplifiers, but isolating resistances are often employed to reduce costs.

Connected or coupled to separate ones of the buses **12, 13, 14, 32, 37** are record-reproduce buses, **41, 42, 43, 44, 45**. The record-reproduce buses each proceeds via selective switches, as **46** via reversely directed parallel amplifiers **47**, to record-reproduce heads **48**, capable of

recording on magnetic tape **49** and transcribing therefrom.

The terminal **24** is connected in cascade with a preamplifier **51**, and the latter in cascade with a phase vibrato modulator **52** having a vibrato source **53** at 7 c.p.s. The output of the phase vibrato modulator proceeds to a power amplifier **54**, which in turn drives a speaker **55**.

In operation, to record, the record switches **46'** are all closed and the reproduce switches **46''** are opened. A selection is then played on the organ by manipulating the switches **11, 31, 36** according to the tone content and tempo of the musical selection. Thereby, separate divisions of the organ record parts of the selection on different tracks, as **50–54**, inclusive. For example, chords are recorded on track **50**, and pedal tones on track **51**. Tracks **52, 53, 54** may then record separate **8'** great and swell tones, and **4'** swell tones, for example.

Having recorded a complete selection on tape **49**, in terms of separate tracks for separate organ division, the tape can be reproduced by heads **48**. However, in reproduction only selected ones or one of reproduce switches **46''** may be closed, if desired. This provides the opportunity to supply the content of unreproduced tracks manually, and is valuable in teaching students, or in practicing. For example, one may practice supplying chords, and for pedal tones, to a solo previously recorded by an expert. One can listen to the chord and solo parts as played by the latter to obtain a feeling for his musicianship. The student can then cut out the chord and supply his own. Similar consideration apply to the solo, and in fact to all organ divisions.

The system is useful not only pedagogically, but also solely for entertainment, since the entire selection, including all parts or divisions, may be simultaneously reproduced, and the student or player may be content to manipulate the stop selectors, or tone filters **15, 16, 17**, by means of stop switches **18, 19, 20**, and the vibrato source and expression pedal.

The provision of means for separate production and reproduction of each organ division provides, then, a device of great flexibility, useful for teaching, or for entertainment.

The tone generators **10** may, depending on the commercial type of organ involved, be sawtooth waves, square waves, or merely complex wave forms of arbitrary shape but rich in overtones. Usually pedal or chord tones are sinusoidal, but this need not be the case, and harmonic rich tones can also be supplied by these generators.

Since all complex wave forms have the function of provided multiple overtones, suitable for tone colouring by means of formant filters, while sawtooth waves are typical of suitable overtone-rich wave forms, I call all such complex wave forms "sawtooth type."

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. The method of producing a complex musical selection of organ or the like tones comprising producing in separate organ divisions harmonic rich current oscillations representing the notes constituting the gamut of an organ scale, separately recording on separate tracks of a magnetic tape all the harmonic rich oscillations derived from each of the separate divisions, the selections being according to said musical selection in tempo and arrangement, reproducing the separate recorded oscillations deriving from the separate divisions from the separate tracks separately and each at will, formant filtering the selected reproduced oscillations to produce tones having a variety of tone colours at will and translating the filtered oscillations into sound.

2. The method according to claim **1** wherein the divisions include a chord division, a swell division, and a pedal division.

3. The method of producing, from separate divisions of an electronic organ, organ tones representative of a musical selection from discrete current oscillations at least some of which are complex wave forms including simultaneously a plurality of harmonics, the selection consisting of an arrangement of notes constituting the gamut of the scale of an organ arranged in order and tempo according to said musical selection and separated into parts of said selection derived individually from the separate organ divisions and recorded on separate tracks of a single magnetic tape, comprising separately reproducing from said separate tracks selected ones of said current oscillations deriving from selected ones of said divisions, formant filtering at least some of said separately reproduced oscillations to provide various tone colours at will, combining all the selected oscillations into a single rendition of said musical selection, and translating the combined oscillations into sound.

4. An automatic electronic music system, comprising an electronic organ including a plurality of organ divisions, each of said divisions having at least one bus, a magnetic tape recorder-reproducer including a plurality of separate record heads and tracks allocated one for each of said buses, means for at will connecting selected ones of said record heads to separate ones of said buses to record the outputs of said divisions on said separate tracks, while said organ is being played, means for reproducing at will from any one or more of the recorded tracks, said last means including a separate tonal channel for each of said tracks connected back to the bus from which the track derives, selective plural formant filters connected in cascade with at least one of said buses, means for combining the tonal outputs of all said buses including said formant filters, and speaker means connected to the means for combining.

5. In an automatic electronic organ comprising plural organ divisions and corresponding tone buses, at least one of said divisions including tone filters selectable at will, multiple channel magnetic tape records, each channel of which contains a record of a partial musical selection derived from only one of said divisions, the selections when simultaneously reproduced constituting a completed musical selection, the combination of means for applying tones deriving from said records simultaneously and individually to said tone-buses, and speaker means for reproducing said tones connected to all said buses simultaneously.

6. In combination, a multiple channel magnetic tape record, each separate channel including a record of a partial musical selection deriving from only one division of an electronic organ, the partial selections being arranged on separate tracks of said record to provide a complete musical selection when simultaneously reproduced and combined, wherein is provided an electronic organ having multiple tone buses, means for reproducing each of said partial musical selections from said tracks and applying each of said partial musical selections as reproduced to a different one of said tone buses, selective formant filters connected in cascade with at least one of said tone buses to provide a partial musical selection having selected tone colours, and means for combining all the partial musical selections including said partial musical selection having selected tone colour.

7. In combination with a multiple track record, each track having a tone record of only a partial musical selection, the partial selections being arranged in corresponding tempo on parallel synchronized tracks of said record to provide a complete musical selection when said tracks are simultaneously reproduced, an electronic organ having a separate division bus corresponding with each of said tracks, and means for at will and selectively applying reproduced tones derived from separate ones of said

tracks to separate ones of said division buses, and key means for actuating said separate divisions to produce audible music simultaneously with said application.

8. The combination according to claim 7 wherein said divisions include selective formant filters for at will adding various tone colours to the wave forms provided on its bus by said divisions and wherein the reproduced tones applied to the division buses are composed of periodic wave shapes each including multiple harmonics of constant amplitude over a long time period.

9. In combination with an electronic organ system, said system including a multiple division electronic organ having at least one separate bus for each of said divisions of a magnetic tape recorder and reproducer having a single tape and multiple record-reproduce devices for individually recording on separate tracks of said tape and reproducing from said tracks, a connection from each of said buses to a different one of said record-reproduce devices, and switching means for at will connecting any

of said devices to its bus selectively in the reproduce and record mode and alternatively in an inoperative mode.

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