

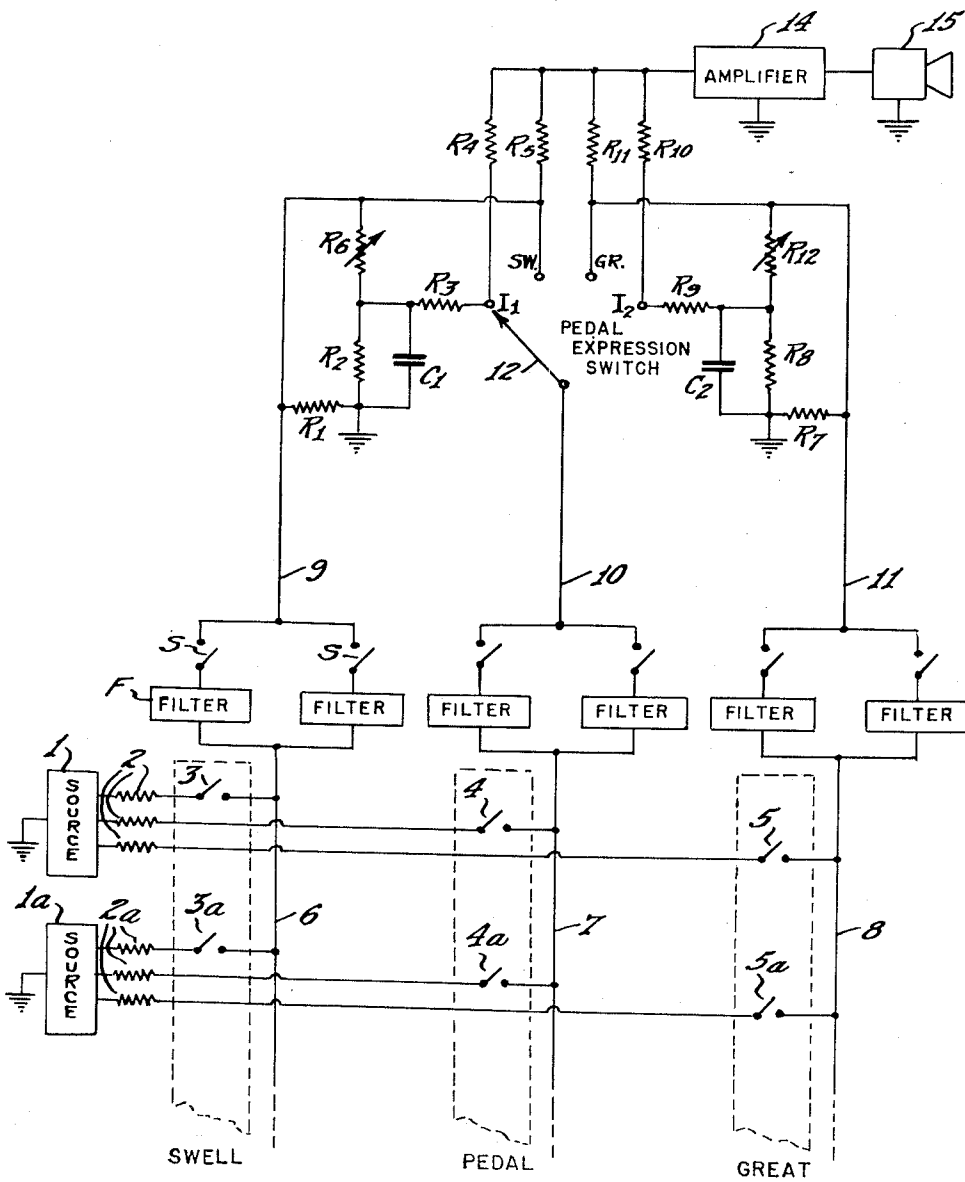
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CONTROL SYSTEM FOR ELECTRONIC MUSICAL INSTRUMENTS

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CONTROL SYSTEM FOR ELECTRONIC
MUSICAL INSTRUMENTS

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My invention relates to electrical musical instruments of the organ type having a pedal keyboard and at least one manual keyboard, which keyboards are employed to select tone signals for transmission from the sources of the signals to an output system for conversion to musical tones.

The conventional pipe organ consists of two or more manual keyboards for selecting pipes in two or more divisions of the organ, these divisions being located in respective enclosures having openings the size of which is controlled in order to control the volume of sound transmitted from each division into the auditorium or room in which the organ is to be heard. Such organs usually also have a pedal keyboard for selecting the tones to be derived from another division of the organ, the pipes of which are usually of such size that they are either in the room or auditorium in which they are to be heard or are in a recess, such as at the back of a stage, which is not cut off from the room or auditorium and, therefore, is not subject to the variations in volume produced in the divisions of the organ controlled by the manuals. Under these circumstances if a soft solo voice is being produced from one of the manually operated sections of the organ, a soft rank of pedal pipes must be used to balance the solo voice, no provision having been made to control the volume of sound derived from the pedal pipes.

In electrical organs wherein the electrical pulsations are amplified and converted into sound in a loud speaker system, it becomes possible to control the volume of sound produced by playing on the pedal keys irrespective of the pedal voice or voices being used. Thus, it would be possible to adjust the pedal volume to appropriate levels through a switch or series of switches or to provide a separate volume control pedal for the pedal output. The first of these expedients, taken alone, is musically inadequate because in the rendition of certain musical compositions, such as those in which a pedal solo is to be accompanied by swell or great voices, or both, more or less continuous variations of the pedal volume are frequently desirable. This can be accomplished, of course, by the second above mentioned expedient. But this necessitates an additional control device in the nature of an additional volume control pedal which adds complexity and expense to the structure and often makes it difficult for the organist to obtain quickly and accurately a certain prearranged volume level for the pedal tones.

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Moreover, it is frequently desirable to control the volume of the pedal tones simultaneously and concurrently with the volume of the swell or great voices. For these reasons in the prior electronic organs with which I am familiar, it has been the practice to provide for control of the volume of the pedal voices concurrently with the volume of the great and swell voices usually by routing the entire output of the instrument through one master volume control pedal, thus effecting a compromise in which desirable versatility is sacrificed.

In plural manual organs a control of the volume of the pedal voices selectively along with either the swell voices or the great voices is desirable, and this presents a problem where separate volume control pedals are provided for the swell and great voices.

Finally, since the general tonal level of the swell voices differs from that of the great voices, it is highly desirable that when the pedal voices are not controlled volumewise together with the voices of either the swell manual or the great manual, that the pedal voices be nevertheless provided with appropriate basic tonal levels which will differ from each other depending upon whether the pedal output is to be used with the swell voices or the great voices.

In the light of these problems, it is a primary object of my invention to provide a control system for electrical musical instruments which will not only make it possible to control the volume of the tones from one division of the organ simultaneously with the volume of tones from another division, but will also make it possible to produce tones from one division with at least one prearranged volume level regardless of the volume level of tones from another division or divisions.

It is a further object of my invention to provide a control system for an electrical musical instrument with which a musician can easily and quickly shift from simultaneous control to independent control of manual and pedal voices and, in an instrument having two or more manuals, may accomplish this at a prearranged volume level for the pedal voices which is appropriate to the volume level of the voices of the manual which is being employed along with the pedal clavier.

It is an object of my invention to provide a switching arrangement by which a musician may easily and quickly shift from simultaneous control of the volume of manual-derived tones and pedal-derived tones to control of manual-derived tones independently of the volume of pedal-de-

rived tones and, in an instrument having a plurality of manuals and a pedal clavier, to provide an arrangement whereby a musician may easily and quickly shift from simultaneous control of the volume of pedal-derived tones with the volume of tones derived from one manual to the simultaneous control of the volume of pedal-derived tones with the volume of tones derived from another manual.

It is a further important object of my invention to provide a simple and inexpensive means for accomplishing the above noted objects, which means may be operated by the musician with ease and certainty.

These and other objects, which will be set forth hereinafter or which will be apparent to those skilled in the art upon reading these specifications, I accomplish by that construction and arrangement of parts of which I shall now describe an exemplary embodiment, reference being made to the accompanying drawing wherein is illustrated a schematic diagram showing my invention as employed with an electronic musical instrument of the analytic type. In such an instrument complex electric oscillations are selectively transmitted through electric filter systems for the production of various tone colors. It will be clear to the skilled worker in the art how my invention may be applied to other instruments such as those in which there is a synthetic derivation of voices.

In the exemplary embodiment, my invention is shown as employed with a system of the type disclosed by Kock in U. S. Patent No. 2,233,948, the Kock circuit being reduced to its bare essentials in order to simplify this disclosure. In the system illustrated, sources of complex oscillations, indicated as the blocks 1 and 1a, have connections through decoupling resistors 2 and 2a to key switches 3 and 3a in a swell manual, 4 and 4a in a pedal clavier and 5 and 5a in a great manual. For example, the sources 1 and 1a may be generators of C and C-sharp signals, it being understood that additional sources, decoupling resistors, and key switches will be necessary for a complete instrument. Collectors 6, 7 and 8 collect the tone signals derived through the key switches of the respective keyboards and transmit them selectively through stop-tab operated switches S of tone-color filters F, which modify the harmonic content of the signals derived from the sources 1, 1a and so forth. The outputs of the respective filters are combined for each keyboard and transmitted through output leads 9, 10 and 11, which, in the exemplary embodiment correspond to the swell, pedal and great keyboards, respectively.

The output lead 9, which carries the tone signals of the swell manual, is connected as shown in the drawing to a network comprising the fixed resistors R-1, R-2, R-3, R-4 and R-5, a pedal-operated variable resistor R-6 (which may be of the type disclosed in U. S. Patent No. 2,498,569 to Mork), capacitor C-1, with a connection as shown to the contact I-1 of a multi-pole pedal expression switch 12. Similarly, output lead 11, which carries the tone signals of the great manual, is connected to a network comprising resistors R-7, R-8, R-9, R-10, R-11, R-12 and capacitor C-2 which has a connection with contact I-2 of the switch 12. The output lead 10 from the pedal keyboard is connected to the movable switch arm of the pedal expression switch 12. The output ends of the resistors R-4, R-5, R-10 and R-11 are connected in common and to an amplifier of

a conventional type indicated by the block 14 and to a loudspeaker system indicated at 15.

The pedal expression switch 12 has been illustrated in the form of a single pole quadruple throw switch, but it will be understood that other switch mechanisms may be employed, inclusive of individual switches to establish or break the various circuits involved with or without mechanism of known character which operates upon the closing of any one switch to open all others in the group. Operating means for the switching mechanism will normally be located on the front board of the organ or elsewhere in a position of easy access to the musician playing the instrument. In the form shown the switch has contacts I-1 and I-2 mentioned above and two additional contacts marked respectively *sw* and *gr*. These contacts are connected respectively to the leads 9 and 11 as shown and also respectively through resistors R-5 and R-11 to the input lead of the amplifier 14.

The resistor R-1 is connected as shown between the lead 9 and ground and its purpose is that of matching the impedance of the resistor network to the impedance of the generators 1, 1a etc. and their decoupling resistors 2, 2a etc., as respects signals coming through the lead 9. The resistor R-7 serves the same purpose with respect to signals coming through the lead 11.

The variable resistor R-6 is connected between lead 9 and ground through the network comprising resistor R-2 and capacitor C-1, and may be thought of as the variable resistor serving as the volume control for the swell manual voices and operated by the swell manual volume control pedal. It is a resistor variable from a very high to a very low impedance and, acting as a bypass to ground, thus controls the volume of signals reaching the amplifier through resistor R-5. The fixed resistor R-2 and its associated capacitor C-1 are inserted into the system for purposes of balance and provide a means for causing the volume of lower frequency signals to be relatively greater at the low signal levels than at high signal levels. Similarly, the variable resistor R-12 serves as the volume control for great manual voice signals coming to the amplifier and loudspeaker through the lead 11, the network comprising resistor R-8 and capacitor C-2 serving the same function as has been described in connection with resistor R-2 and C-1.

If the contact arm of the pedal expression switch 12 lies in contact with the pole or element *sw*, it will be seen that the variable resistor R-6 is in a position to act as a bypass to ground for signals from the pedal clavier passing through lead 10. Consequently, operation of the swell manual volume control pedal will concurrently and simultaneously control the volume of the swell manual voices and the pedal clavier voices irrespective of the nature of these voices. If the contact arm of switch 12 is shifted to the position shown in the drawing, i. e. a position in which contact is made with pole I-1, signals through lead 10 from the pedal clavier will reach the amplifier through resistor R-4 and the variable resistor R-6 is no longer in a position to control the volume of the pedal clavier voices although it will still control the volume of swell manual voices. The pedal voices have now become independent of the swell manual voices. At the same time it will be noted that there is a connection between the pole I-1

and the network comprising resistor R-2 and capacitor C-1 through a resistor R-3, the value of which is so chosen as to give to the now independent pedal voices an over-all or general volume appropriate to the over-all or basic volume of the swell manual tones.

In a similar fashion, when the contact arm of the pedal expression switch 12 lies in contact with the pole *gr*, the pedal-derived signals will pass to the amplifier 14 through resistor R-11 to which the lead 11 is also connected so that the variable resistor R-12 of the great manual volume control pedal is now in a position to control simultaneously the volumes of the great manual voices and the pedal voices. When the movable arm of switch 12 is shifted into contact with pole I-2, the pedal voice signals reach the amplifier independently through resistor R-10 and are no longer controlled by the great manual volume control resistor R-12, although that resistor, operated by the great manual volume control pedal, still controls the volume of the great manual voices. At the same time, the pole I-2 is connected to the network comprising resistor R-8 and capacitor C-2 through a resistor R-9 which modifies the general level of the pedal voice volume to a value appropriate to the basic level of the great manual voice volume.

The general or basic levels of the great manual voices are generally higher than those of the swell manual voices and when this is the case, the value of resistor R-9 will be higher than that of resistor R-3, or there will be a difference in the values of resistors R-4 and R-10, or both. It will be noted that the poles I-1 and I-2 are located respectively adjacent the poles *sw* and *gr* so that if the musician has been playing a portion of a composition requiring the simultaneous control of the volume of the swell manual voices with the volume of the pedal voices, and for another portion of the composition desires to make the volume of the pedal voices independent of the volume of the swell manual voices while retaining the over-all balanced relationship, he can easily shift the switch 12 from *sw* to I-1 without bringing it into contact with the poles *gr* or I-2, thus avoiding a surge in the sound level of the pedal voices. If the movable arm of switch 12 is made rotatable through 360 degrees, it becomes possible to pass from pole I-1 to pole I-2 without going through either position in which the pedal voices would be affected by the swell or great manual volume control pedals.

In adapting my invention to various instruments, different values for the resistors and capacitors mentioned above may be chosen. The following is an exemplary set of values for an instrument in which the impedance to ground from the collectors 6, 7 and 8 is of the order of 5000 ohms:

Table I

R-1, R-7-----	6,800 ohms
R-2, R-8-----	2,200 ohms
R-3-----	3,300 ohms
R-4-----	33,000 ohms
R-5, R-11-----	10,000 ohms
R-13, R-14-----	10,000 ohms
R-9-----	4,700 ohms
R-10-----	15,000 ohms
R-6, R-12-----	350 ohms to 100 megohms (variable)
C-1, C-2-----	1.5 microfarads

While my invention is of greatest utility as applied to instruments of the organ type having a plurality of manuals and a pedal clavier, it is also of utility in connection with simpler instruments having a single manual and a pedal clavier since it enables the organist at will to control the volume of the pedal voices with the volume of the manual voices or to free the pedal voices of such control while still maintaining them at an appropriate, general level. From the description above, it will be clear how the principles of my invention may be adapted to instruments which have, in addition to a pedal clavier, a plurality of more than two manuals, each with an independent volume control pedal. While one of the valuable advantages of my invention is that it gives a very high degree of versatility in an instrument without the complexity and expense of the provision of a separate volume control pedal for the pedal clavier voices, it does not preclude the use of such a pedal if desired for any other reason, nor does it preclude the use of volume control means desired for control or adjustment of the over-all pedal volume. Any such means may be inserted in the lead 10.

Modifications may be made in my invention without departing from the spirit thereof. Having thus described my invention in an exemplary embodiment, what I claim as new and desire to secure by Letters Patent is:

1. In an electrical musical instrument having sources of tone signals, a set of pedal keys, at least one set of manual keys, an output system and means associated with respective keys in said sets for selecting which sources are to be connected to said output system for conversion to sound of tone signals from selected sources, the combination of collectors associated respectively with each set of keys for collecting signals selected thereby, and an electrical network between said collectors and said output system, comprising a multipole switch, variable impedance means for each set of manual keys, a path between the pedal collector and the output system via one pole of said switch and a path including said variable impedance means and a connection to said switch between each manual collector and said output system, whereby selectively pedal signals may be transmitted to said output system at a prearranged level and may be transmitted to said output system along with manual signals for simultaneous control by said impedance means.

2. In an electronic organ having two manual keyboards, a pedal keyboard, sources of tone signals, an output system, and means in connection with the respective keys of said keyboards for selecting signals from said sources for translation into sound by said output system, the combination of common channels for respective keyboards for transmitting signals selected by keys of respective keyboards to said output system, a four-pole switch, variable impedance elements in connection with respective channels for said manual keyboards, connections from two adjacent poles of said switch to respective channels from said manual keyboards, two paths of different fixed impedance connecting the remaining two poles of said switch to said output system, said selector being connected to the channel from said pedal keyboard, whereby selectively the signal level of the signals selected by said pedal keyboard may be controlled by either of said variable impedances along with the signals selected by either of said manuals and may be maintained at

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either of two different values independently of the signal level of signals selected by said manual keyboards.

3. In an electrical musical instrument of the type in which complex electric oscillations are derived from a series of generators through series of key switches respectively associated with the keys of a plurality of manual keyboards and of a pedal keyboard for transmission to an electro-acoustic output system, a plurality of pedal operated volume control means associated respectively with said manual keyboards and switching means associated with said volume control means operative to bring the oscillations derived through the key switches of said pedal keyboard selectively through any one of said plurality volume control means for said manual keyboards or directly to said output system, whereby selectively the volume of pedal notes may be varied selectively along with notes of any one of said manuals and will remain at a volume level independent of the volume of said pedal notes.

4. In an electrical musical instrument of the keyboard type having a pedal clavier and at least one manual, sources of electrical oscillations connectible respectively through keys of said clavier and manual to independent collectors, an output system including an amplifier and a loudspeaker, a connection between the said manual lead and the said output system including a variable impedance acting as a volume control, and selective connections between said pedal clavier lead and said output system, one of which connections bypasses said volume control impedance and the other of which includes said volume control impedance.

5. In an electrical musical instrument of the keyboard type, a pedal clavier and at least two manuals, sources of electrical oscillations connectible through keys of said clavier and manuals respectively to said leads, independent connec-

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tions between the manual leads and an output system, including an amplifier and a loudspeaker, said connections including variable impedances serving as volume control means, and a plurality of selectively effectible connections between said pedal clavier lead and the output system, certain of said selective connections bypassing said variable impedances and others of said selective connections each being inclusive of one of said impedances.

6. The structure claimed in claim 5 in which said first mentioned selective connections include fixed impedance means of differing values for the purpose of effecting over-all volume control of signals in said pedal clavier lead.

7. In a keyboard musical instrument of the type in which generated electrical oscillations are selected by keys and converted into sound in a loudspeaker, a pedal clavier and a manual each having keys, independent leads in which oscillations are derived from the operations of the keys of said manual and clavier respectively, said manual lead having connection with an output system including an amplifier and said loudspeaker, said connection having a variable impedance bypass to ground serving as a volume control, said bypass including a resistor-capacitor balance network, and selective means for connecting the said pedal clavier lead to said first mentioned connection whereby said variable impedance will control also the volume of oscillations passing to said output system from said pedal clavier lead, and for connecting said pedal clavier lead directly to said output system, said last mentioned connection including a bypass connection to said balance network on the ground side of said variable impedance.

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No references cited.