

Nov. 3, 1942.

V. I. ZUCK

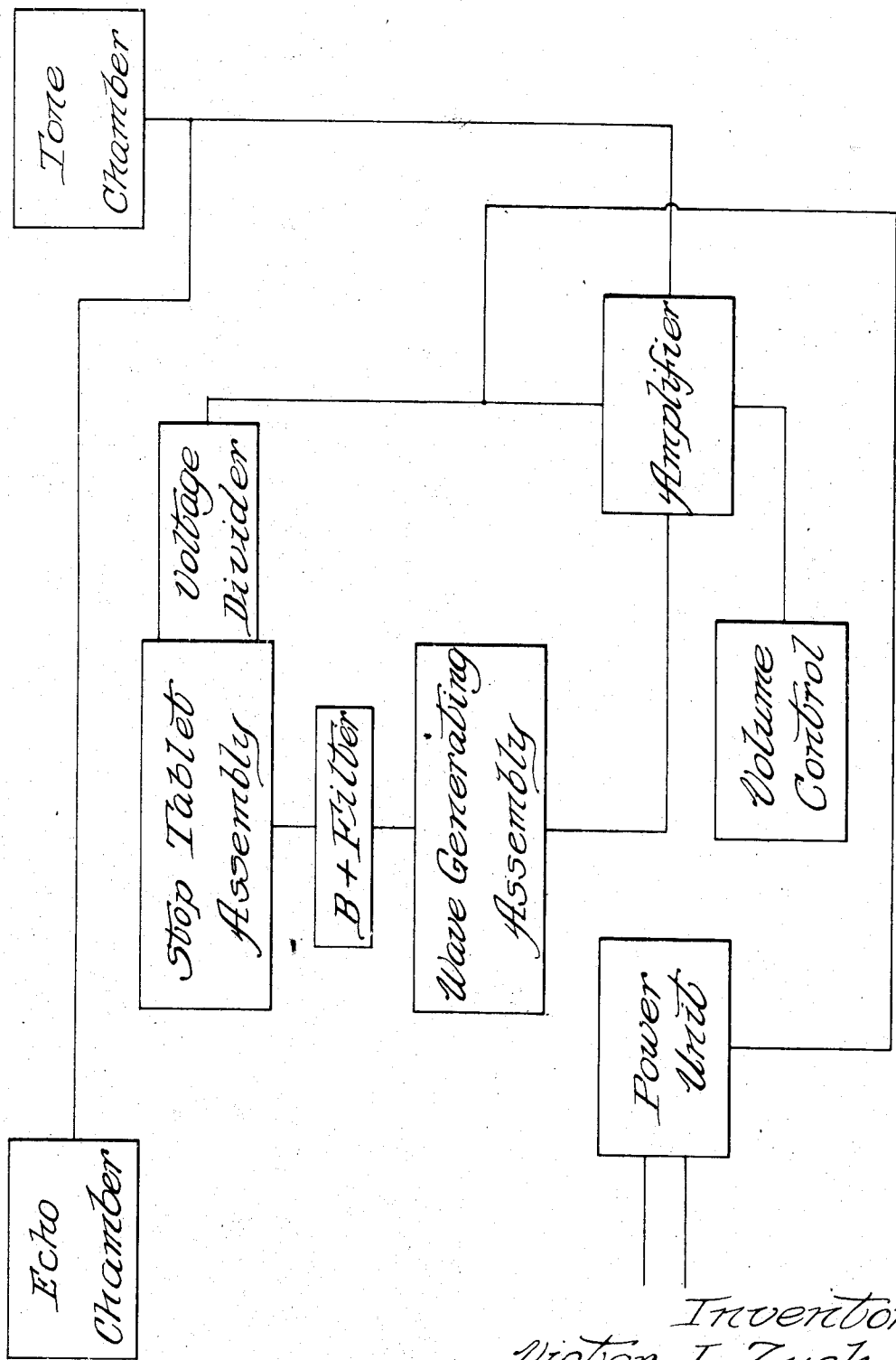
2,300,609

ELECTRIC MUSICAL INSTRUMENT

Filed June 8, 1940

2 Sheets-Sheet 1

Fig. 1.



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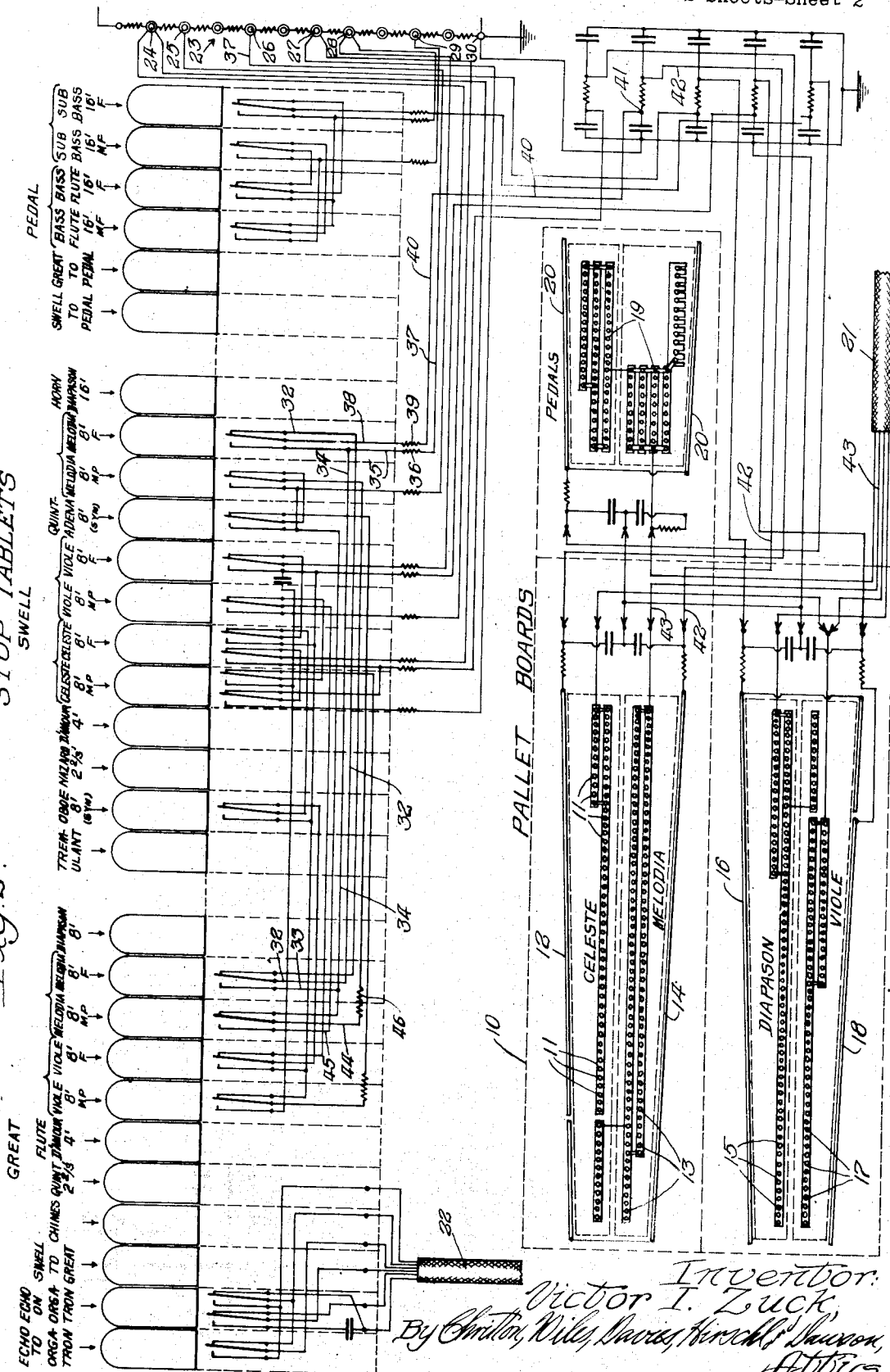
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Fig. 2.
STOP TABLETS
SWELL



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UNITED STATES PATENT OFFICE

2,300,609

ELECTRICAL MUSICAL INSTRUMENT

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Application June 8, 1940, Serial No. 339,557

3 Claims. (Cl. 84-1.09)

This invention relates to an electrical musical instrument, and more particularly to an electric organ having means for predetermining the ratio of amplitude of impulses generated by two different sets of reeds when two or more sets of reeds, or stops, as they are known in organ nomenclature, are played simultaneously.

One feature of this invention is that it provides means for varying the amplitude of electrical impulses generated by a particular set of reeds; another feature is that it enables any of several predetermined voltages to be applied between a particular set of reeds and its associated pick-up; a further feature of this invention is that it provides means for predetermining the ratio of impulses generated by the various sets of reeds, so that one may be accentuated and the other subordinated; yet another feature of this invention is that it includes means for preventing undesired sound impulses resulting from operation of the voltage-varying means; other features and advantages of this invention will be apparent from the following specification and the drawings, in which:

Figure 1 is a block diagram of an electric organ embodying this invention; and Figure 2 is a circuit diagram of particular parts of the organ, more particularly the stop tablet assembly, voltage divider, B+ filter, and wave-generating assembly.

An electric organ has a great many advantages over a pipe organ, particularly as to the space occupied, ease of installation, and flexibility of operation. In this latter regard, for example, it is frequently desirable to subordinate the sounds of notes being played on one keyboard to those being played on another keyboard of a multiple keyboard organ, as where the melody is being played upon one keyboard and harmony on another. The arrangement which I am here disclosing and claiming enables this to be done in a very convenient and simple manner by providing a number of pairs of stop tablets which are duplicates except for the amplitude of the impulses generated. For example, instead of a single stop tablet for actuating the mechanism corresponding to an eight-foot Violon pipe, there are two such tablets; and they are so arranged that impulses generated by playing the keys of the particular keyboard with which these tablets are associated differ only in the amplitude of impulses. Moreover, the amplitude-varying means is prior to the main amplifier of the electric organ, so that the conventional means for varying the general volume of the music is effective thereafter.

Referring first to Figure 1, the general operation of such an organ will be readily understood. Electrical energy, derived, for example, from the usual commercial power line, is transformed by a power unit into a supply of a plurality of direct current voltages which are used to operate the various apparatus. The single lines connecting the various blocks representing various parts of the organ are for illustrative purposes only, as it will be understood that these units are all connected by a plurality of wires, and in some cases units are interconnected in various further ways than the basic paths illustrated in Figure 1.

Voltages of various values in the voltage divider are selected in the stop tablet assembly, in accordance with the keyboard desired to be played and the amplitude and type of note desired. This voltage is then passed through a filter and applied between a particular set of metallic reeds and its associated pick-up in the wave generating assembly. This assembly includes a plurality of such sets corresponding to different types of instruments, or the different types of tonalities produced by a pipe organ, such as the Diapason, Flute, and the like, the arrangement being such that mechanical vibration of a particular reed in the set energized, resulting from depressing a key in the keyboard being played, is converted into electrical impulses corresponding to such vibration. These impulses are then supplied to the input of a single main amplifier, where they are considerably amplified, and they are then delivered to either a tone chamber or an echo chamber, or both. These chambers include means for transforming the electrical impulses into sound impulses, as further amplifiers and loudspeakers. Associated with the main amplifier is a volume control, usually pedal-operated, to vary the average or general volume level of the instrument. This is to be distinguished from the previous amplitude-varying means, which varies the amplitude of impulses generated by the various sets of reeds with relation to each other.

Turning now more particularly to Figure 2, this will be seen to be a detailed diagrammatic showing of the parts particularly concerned with wave generation and the control thereof, that is, the voltage divider, the stop tablet assembly, the B+ filter, and the pallet boards with the reed sets and pick-ups thereon. In this regard, the means for vibrating individual reeds of the various sets has not been illustrated, as it involves no part of the present invention and would unduly complicate the showing. It will be understood, of

course, that the organ comprises the usual keyboard and mechanism operated by depressing particular keys to actuate valves admitting air to the cells of the reeds corresponding to the keys depressed, in order to effect the desired mechanical vibration of the reeds.

Turning first to the pallet boards and wave-generating assembly indicated in general as 10, it will be seen that this comprises a plurality of sets of elements which may be vibrated upon depression of a particular key. In the preferred embodiment of my invention these elements comprise metallic reeds prevoiced to provide a desired tone quality, arranged in sets of the number of notes desired for a particular type or quality of sound. These sets of reeds correspond to the partial organs or individual systems of pipes; and in the particular organ here illustrated the partial organs or sets of reeds are identified as Celeste, Melodia, Diapason, Viole, and Pedal, or Bass. The reeds of each set are arranged in a row of adjacent cells, and a portion of a metallic pick-up, as an adjustable screw, is arranged to have a part spaced from the reed at a distance just barely exceeding the maximum expected vibration of the reed. Each of these screws associated with the reeds of a particular set are electrically connected together and serve as part of a pick-up converting mechanical vibration of the reeds into corresponding electrical waves or impulses. By creating a voltage differential between the metallic reed and its associated pick-up element, mechanical vibration of the reed varies the capacity between these two elements. The reeds and pick-ups are connected in the input circuit of a main amplifier, and variations in the capacity cause fluctuations in the grid of the first amplifier tube and these impulses are then amplified through succeeding tubes to an extent determined by the setting of the volume control.

In the particular wave-generating assembly illustrated in Figure 2 the Celeste reeds are identified as 11, and the Celeste pick-up as 12; the Melodia reeds as 13 and the Melodia pick-up as 14; the Diapason reeds as 15 and the Diapason pick-up as 16; the Viole reeds as 17 and the Viole pick-up as 18; and the bass or Pedal reeds as 19, their associated pick-up being 20. When voltage is applied between a particular set of reeds and their pick-up the operation of a key causes vibration of its corresponding reed, which results in electrical impulses from this set of reeds being delivered, through one of the four wires in the shielded cable 21, to the input or grid circuit of the first tube in the main amplifier. The desired output volume is effected by adjustment of the volume control, and the amplified impulses delivered to either the principal loud speakers or the echo speakers, or both. Choice in this latter regard is effected by electrical means, as by operation of the first two stop-tablets on the left of the tablet assembly, through their connections in the shielded cable 22.

I have found that it is desirable to enable a predetermined ratio of amplitude of impulses developed in two or more sets of reeds, or partial organs, during general volume variations effected by the foot pedal volume control. I have accomplished this by enabling selection of the voltage to be applied between the reeds and pick-ups of any particular set, so that if the voltage applied to one set and its associated pick-up is double that applied to another set and its pick-up, it will be seen that the amplitude of impulses de-

rived from the first system will be approximately double that derived from the second, as the impulses are supplied to the input of the main amplifier. These various electrical impulses are kept separate until they are supplied to the amplifier, and reaction between one and the other is prevented by having four separate input tubes, the plate circuits of these tubes being connected in parallel to the next succeeding amplifier stage.

In order to have a source of a plurality of different voltages readily available I make use of a voltage divider, here indicated in general as 23. One end of this voltage divider is supplied with a fairly high voltage, as for example 305 volts positive in a particular embodiment of this invention, whereas the other end of the divider is grounded. The voltage is, of course, derived from the power supply unit; and the ground may be an actual one, or merely an artificial one to the frame of the instrument. At any rate, it represents the other or negative terminal with respect to which the operating potential is 305 volts positive. The voltage divider comprises a plurality of fixed resistors, here shown as eleven in number, arranged in series with terminals therebetween to enable any desired voltage to be tapped off. In a particular embodiment of this organ the terminal 24 supplies 254 volts; the terminal 25, 204 volts; the terminal 26, 132 volts; the terminal 27, 92 volts; the terminal 28, 71 volts; and the terminal 29, 30 volts, all of these potentials being positive with respect to ground, or the terminal 30.

In the particular form here illustrated, the organ consists of three partial organs or systems, great, swell, and pedal, each having a keyboard and associated stops. That is, the console includes two manuals and a foot keyboard; and the stop systems, identified as Great, Swell and Pedal, connect various reed sets to the corresponding keyboards.

Each system of stops contains various general control stops, such as echo, tremulant, and the like; and stops determining the quality of note that will result when a particular key is depressed on the associated keyboard. In this latter regard, it will be seen that Viole, Celeste, Melodia, Diapason, Flute, Oboe and other qualities may be attained by operation of the stops, here illustrated as stop tablets.

Certain of the more frequently used stop tablets are duplicated, the connections to the switches operated by the tablets being such that the quality of the notes of such pairs of tablets is exactly the same, but the amplitude differs. This enables a Viole quality, for example, to be played on the Great manual as a background to a Celeste quality of note, for example, played on the Swell manual. That is, it enables the ratio of amplitudes or volumes to be predetermined before the impulses enter the main amplifier, so that even though the general volume of the organ is raised or lowered the desired ratio of amplitude between melody and harmony, for example, will be maintained. It will be seen that this is accomplished by having the duplicate tablets of the various pairs actuate the same reed sets, but with a different voltage between the reeds and their associated pick-ups.

Turning to the Great tablet system as an illustrative example, it will be seen that it comprises two pairs of duplicate tablets, each pair being bracketed for convenience in identification. One pair actuates reeds from the Great keyboard which give a tone quality correspond-

ing to an eight-foot Melodia pipe. One tablet in each case, however, results in a higher amplitude of initial impulse generated, by reason of the application of a higher voltage; and this tablet is in each case marked "F" for forte.

Considering first the pair of Melodia stop tablets in the Great system of tablets, it will be seen that each operates a two-way switch. When the tablet is in its normal position the movable element of the switch is to the right, speaking with respect to the parts as shown in Figure 2; and when the stop tablet is depressed the center movable element is moved over to the left, to make contact with a different switch element. In each case the center or movable member of the switch is connected, either directly or indirectly, to the Melodia pickup; and the lefthand contacts of the switches are connected to a portion of the voltage divider to supply a voltage when the contacts are closed.

Considering first the Melodia 8' F tablet, when this is depressed the wire 32 is connected to the wire 33. Following the wire 33 back, it will be seen to pass through the wire 34 to the wire 35; thence through a resistor 36 of high value to suppress undesired interference when the contacts are closed; and further through the wire 37 to the terminal 26, the 132-volt terminal of the voltage divider. To follow back the connection from the wire 32, this wire connects, through a pair of normally closed contacts, to the wire 38; the circuit connection then continues through a suppressor resistor 39 and wire 40 to terminal 41 in the filter unit. The voltage, smoothed by the action of the filter, is then applied through the wire 42 to the pick-up 14 associated with the Melodia reeds. The Melodia reeds are all connected in parallel to the wire 43, which leads through the shielded cable 21 to one of the input tubes of the main amplifier. Depressing any particular key on the Great keyboard will thus result in mechanical vibration of the corresponding note in the Melodia system, resultant variation in the capacity between it and the pick-up, and resultant variation in voltage on the grid of one of the input tubes in the main amplifier, which impulses eventually are converted into sounds of the desired quality and pitch. If it is desired to subordinate the Melodia effect, however, to some other quality of note being played on another keyboard, the Melodia 8' F tablet may be left up and the Melodia 8' MP tablet may be depressed. This results in connecting the wire 44 to the wire 45. The wire 44 is connected, through a suppressor resistor 46, through a pair of normally closed switches, to the wire 32, and thus to the Melodia pick-up. The wire 45 may be followed back toward the voltage divider, where it will be seen to be connected to the terminal 28. Thus, if this other tablet of the Melodia pair is depressed there will be only seventy-one volts between the Melodia reeds and the pick-up, so that the amplitude of the impulses generated by vibration of the Melodia reeds will be considerably smaller, approximately half.

It is believed to be unnecessary to follow out in detail the circuits of the other pairs of stop tablets in the various tablet systems. In each case it will be found that the two tablets of any given pair energize the same reed systems, but with different voltages, the higher voltage in each case being supplied when the F tablet is depressed. This enables a desired degree of flexibility of ratio to be attained when effects

of two different quality or timbre are desired simultaneously, while desired expression may still be attained through the foot pedal general volume control. It has been found that fixed voltages of two or three values are preferable to providing a potentiometer or similarly continuously variable voltage source, as the organist can more readily handle operation of certain stops, during playing, than changes in the setting of a potentiometer.

It has also been found necessary to employ suppressor resistors of high value, as for example twenty-five to one hundred thousand ohms in series with the contacts of the various switches, in order to prevent undesired interference and reaction on other portions of the systems when the switches are operated. Without such resistors, clicking and similar sharp wave front impulses are created in the electrical system which in turn result in undesired sounds from the speakers. Moreover, it is preferable to have each pair of contacts bridged by a condenser, although limitations of space have prevented the showing of a condenser between each pair of contacts in the circuit drawing of Figure 2.

While I have described and claimed certain embodiments of my invention it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. Apparatus of the character described for an electric organ having a plurality of sets of metallic reeds adapted to be vibrated, each set producing tones of different and predetermined complex quality, separate metallic pick-up means associated with each set, an amplifier for amplifying impulses delivered thereto, and means for converting the amplified impulses into sound, including: a source of a plurality of different voltages; a plurality of pairs of stops; separate switch means associated with each of the stops; a connection from each set of reeds and associated pick-ups to one side of one of the switch means associated with at least one pair of stops; a connection from the other side of said switch means to a point on said voltage source; connections from the same reeds and associated pick-ups to one side of the other switch means associated with such pairs of stops; a connection from the other side of this last-mentioned switch means to a different point on the voltage source, whereby mechanical movement of the reeds is converted into corresponding complex electrical impulses of an amplitude depending upon which stop of the pair is operative; and a circuit for delivering said impulses to the amplifier.

2. Apparatus of the character described for an electric organ having a plurality of sets of metallic reeds adapted to be vibrated, each set producing tones of different and predetermined complex quality, separate metallic pick-up means associated with each set, an amplifier for amplifying impulses delivered thereto, and means for converting the amplified impulses into sound, including: a source of a plurality of different voltages; a plurality of pairs of stops; separate switch means associated with each of the stops; circuits connecting said source to the reeds and pick-ups through the switch means, the connections being such that the switch means associated with each pair of stops energize the same set of reeds and

pick-ups with different voltages, whereby mechanical movement of the reeds is converted into corresponding complex electrical impulses of an amplitude depending upon which stop of the pair is operative; and a circuit for delivering said impulses to the amplifier.

3. Apparatus of the character described for an electric organ having a plurality of generators, each generator being adapted to independently produce a complex electrical wave corresponding to a musical tone of the desired quality, an amplifier for amplifying impulses delivered thereto, and means for converting the amplified impulses

into sound, including: a source of a plurality of different voltages for actuating said generators; a plurality of pairs of stops; separate switch means associated with each of the stops; circuits connecting said source to the generators through the switch means, the connections being such that the switch means associated with each pair of stops energize the same generator with different voltages, whereby complex electrical impulses are generated of an amplitude depending upon which stop of the pair is operative; and a circuit for delivering said impulses to the amplifier.

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