

Jan. 28, 1941.

V. J. MOHLER

2,229,759

VOICING PANEL

Filed July 10, 1939

3 Sheets-Sheet 1

*Fig. 1.*

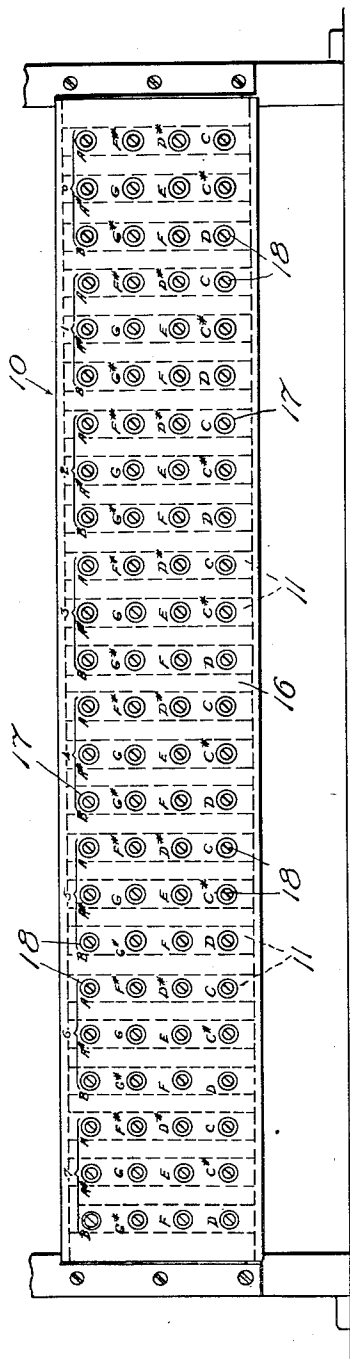
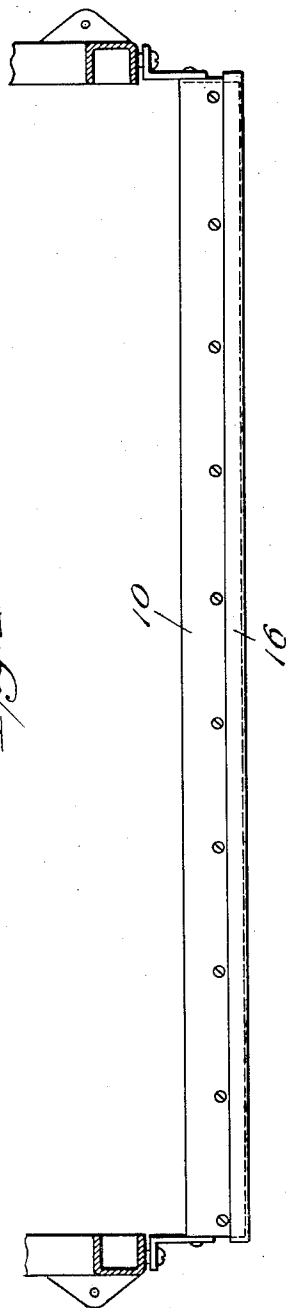


*Fig. 2.*



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Fig. 4.

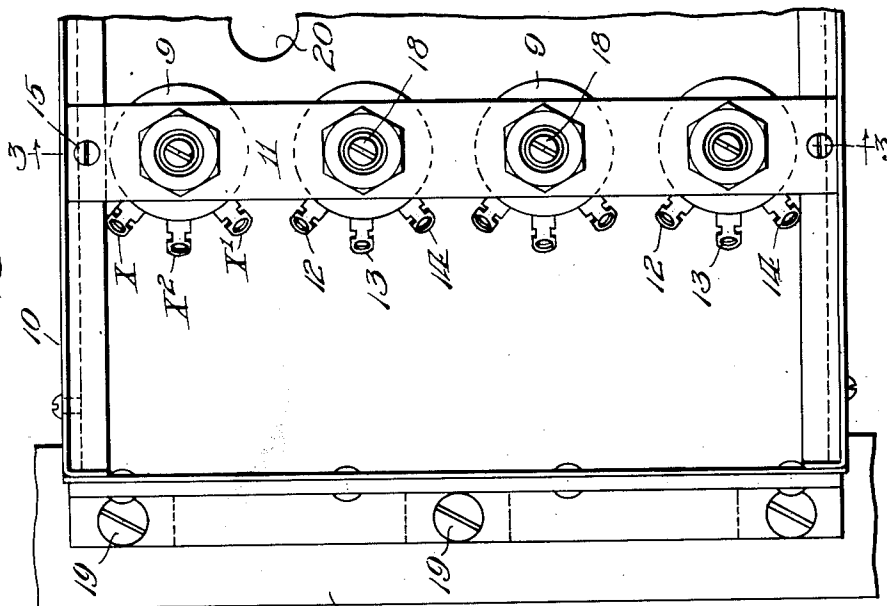
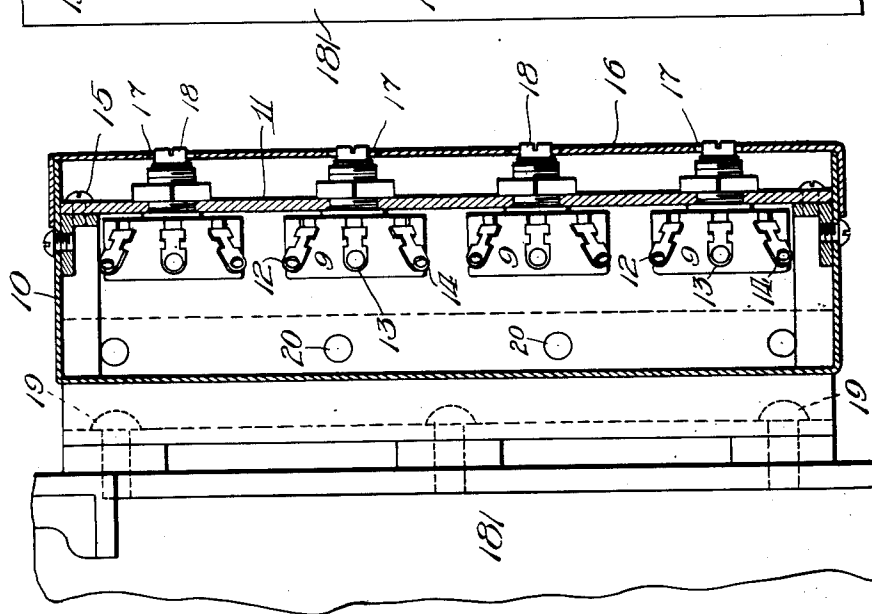


Fig. 3.



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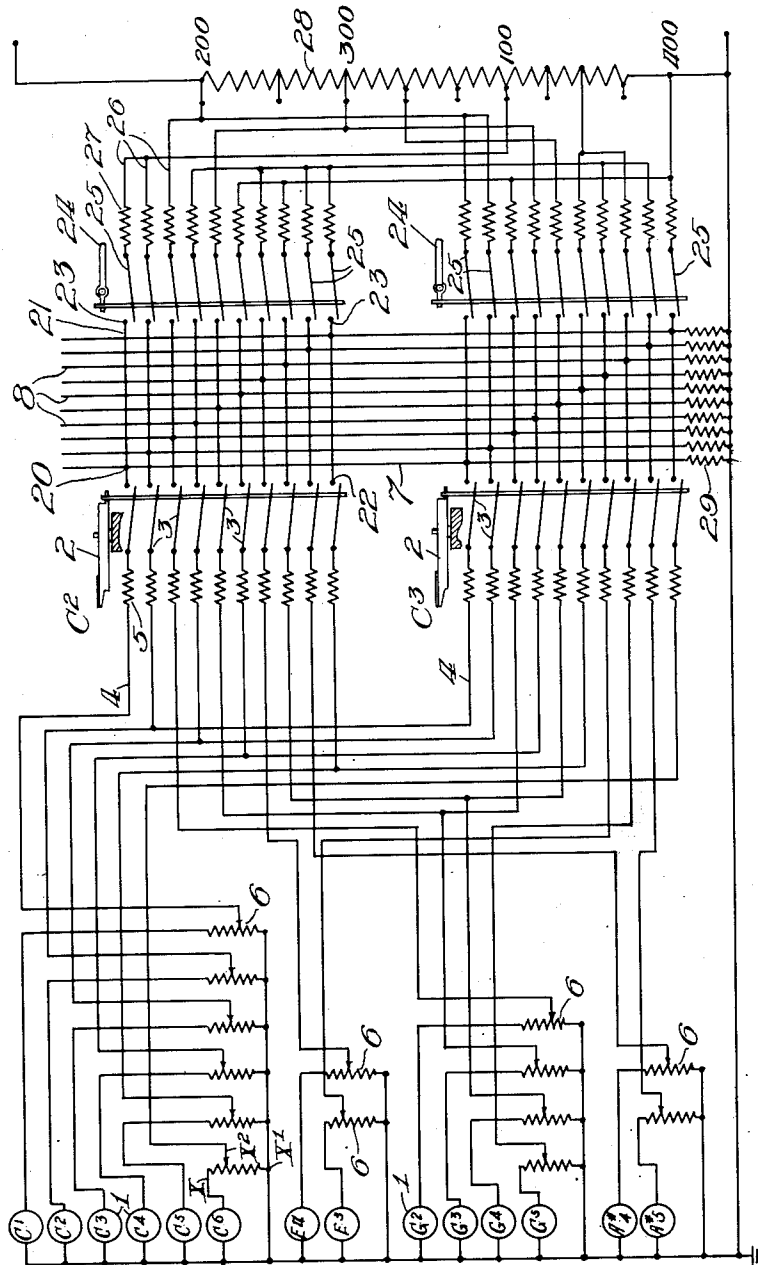
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**3 Sheets-Sheet 3.**



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## UNITED STATES PATENT OFFICE

2,229,759

## VOICING PANEL

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a corporation of Illinois

Application July 10, 1939, Serial No. 283,546

2 Claims. (Cl. 84-1.11)

My invention relates to the class of electrical musical instruments employing alternators or equivalent sources of electrical energy respectively supplying alternating voltages at the tone frequencies of different musical notes and adapted to be synthesized into any selected tone quality.

More specifically, the invention relates to musical instruments, the alternating voltage sources of which are each provided with means by which the amount of voltage to be drawn from any source can be controlled as desired.

Certain of the more important objects of my invention are as follows:

To provide means which is visually indicative of the note relationship to each other of the various alternating voltage sources and the relation of any such source to an associated voltage controlling-device, whereby the amount of voltage necessary to be drawn from any source can be quickly and accurately regulated by a voicer.

To provide means for centralizing the voltage controlling-devices so to dispose all thereof within convenient reach of the voicer.

To provide a voicing panel for electrical musical instruments which is insertable as a unit in an electrical network employing the aforesaid alternating voltage sources.

To provide a voicing panel for electrical musical instruments in which all of the voltage controlling devices are disposed, designed and adapted readily to be connected in the control circuits of said network.

To provide means constituting a common mounting for a system of voltage controlling devices such that said devices are housed and shielded from the effects of stray flux fields and whereby any such device can be controlled at will from a point exteriorly of said housing.

Other objects and advantages of the invention will appear upon reference to the hereto annexed specification and the accompanying drawings in which—

Figure 1 is a face view of my voicing panel showing same applied to the frame members of a console.

Figure 2 is a plan view thereof showing the frame members of the console in section.

Figure 3 is a transverse section on an enlarged scale through the panel with the console frame in full lines.

Figure 4 is a face view of a portion of the panel with the cover plate removed, and

Figure 5 is a diagrammatic illustration of an electrical network in which my panel is used.

In carrying my invention into practice, use is

made of a panel consisting of a casing 10 of shielding material, the same open at one side and provided with longitudinally spaced apart cross-bars 11, upon each of which is mounted a set or vertical row of spaced apart potentiometers 9. Said potentiometers are provided with terminals 12, 13 and 14 which project laterally from one side of the cross-bar so as to be readily accessible when electrically connecting them with circuits in the electrical network which I will describe presently. Said cross-bars are removably secured to the interior of the casing by screws 15 so that each set or vertical row of potentiometers can be applied to or removed from the casing as a unit.

Removably fitted to the open side of the casing is a cover plate 16 which is also of shielding material and provided with longitudinal and vertical rows of holes 17 such that there is one such vertical row for each set or vertical row of potentiometers as will be readily understood upon reference to Figures 1 and 3 of the drawings. Hence, the holes are disposed in coaxial alignment with the adjusting screws 18 of said potentiometers. In this manner, any potentiometer can be controlled as desired from the exterior of the casing when the cover plate 16 is applied.

The front of the cover plate 16 is lettered so that each hole 17 denotes some particular note of a musical scale. The invention is used particularly in a musical instrument adapted to produce tones of the equally-tempered scale, and it is noted that the lettering of said holes is executed in such manner that each group of twelve such holes represents an octave. In the instant embodiment of my invention, eight groups corresponding to a like number of octaves are employed and reading from right to left in Figure 1, these are numerically distinguished from each other by the numbers 0, 1, 2, 3, 4, 5, 6 and 7 above said groups. The holes in each group, reading across the longitudinal rows from right to left and continuing upward from the bottom, are respectively distinguished from each other by the letters C, C#, D, D#, E, F, F#, G, G#, A, A#, and B.

At 19 is shown the rear of a portion of the frame of a console to which said casing 10 is removably secured at 19, and formed in the walls of said casing are outlet holes 20 through which electrical connections from the terminals 12, 13, and 14 of said potentiometers can be run and connected in the electrical network of the instrument.

In electrical musical instruments employing

well known types of alternators for developing alternating voltages at the tone frequencies of the notes of the musical scale, the developed voltages are selectively impressed upon circuits of an electrical network upon actuation of playing keys, thence selectively conducted to synthesizing and sound producing systems where they are graded as to relative intensities and converted into audible sound of the tone quality denoted by a particular drawn stop. Among the various types of alternators are included the one disclosed in the patent to Thaddeus Cahill, No. 1,107,261, dated Aug. 18, 1914, and the one disclosed in the patent to Floyd A. Firestone, No. 1,953,753, dated April 3, 1934, in the former of which, alternating voltages are generated electromagnetically by rotating members operating at different angular velocity in the presence of pick-up magnets, there being produced in each magnet electrical vibrations or periodic flux changes, the frequency of which is determined by the number of teeth or lobes on a member and the angular velocity of said member relative to the tip of the core of an associated magnet. In the device of Firestone, alternating voltages are developed electrostatically as a result of periodic changes in capacitance between electrodes, the rates being determined by the angular velocity of a rotating member and the number of active surfaces or lobes upon said member. The Cahill device is of low impedance whereas the Firestone device is of high impedance. In either of the aforesaid well known types of alternators, the voltage produced is always proportional to the rate of change between the relatively moving parts thereof. In the device of Cahill this is due to the change of flux in a magnet, whereas in the Firestone device it is due to the change in capacitance between parts of a continuously varying condenser. It therefore follows that as each device in an electrical system employing a multiplicity of such devices is designed, constructed and adapted to develop alternating voltage at a frequency different from that developed by any other device in said system, the amount of voltage developed by each said device will be different from that developed by any other device.

My invention is used in an electrical network disclosed in the copending application of James Manatt, Ser. No. 283,554. In said network sources of electrical energy respectively produce alternating voltages in accordance with a scheme of tone combinations made effective by the control of playing-keys and stops. In Figure 5 of the accompanying drawings, the network is shown to embody assemblies of individual energy sources, each thereof designed to provide alternating voltage of the tone frequency of a predetermined note of the equally-tempered musical scale. The assembly at the upper left hand portion of said figure comprises six individual sources, respectively developing alternating voltages at the tone frequencies of the notes C1, C2, C3, C4, C5 and C6. The next assembly beneath it comprises two sources, respectively developing alternating voltages at tone frequencies of the notes E4 and E5. The next lower assembly comprises four sources respectively developing alternating voltages at the tone frequencies of notes G2, G3, G4 and G5. The two sources comprising the bottom assembly respectively develop alternating voltages at the tone frequencies of notes A#4 and A#5. In practice, said electrical network preferably includes twelve identical assemblies

of alternating voltage sources as disclosed in my co-pending application Ser. No. 203,891, each source in any assembly developing alternating voltage corresponding to the tone frequency of a note of the equally-tempered scale. Each assembly will have any desired number of individual sources depending upon the number of pitches required for a given number of octaves. In my co-pending application I show eight such sources per assembly, each assembly developing alternating voltages at the tone frequencies of notes of the same letter.

The playing-keys 2 are each thereof provided with a set of ten individual switches 3 and to each of which is connected an output circuit connection 4 from a particular one of the aforesaid alternating voltage sources, the method of connecting the switches with said sources being such that switches of different keys connect with the same source.

In each circuit connection 4 is a series resistor 5 and connected across the output of each of said alternating voltage sources and in shunt to ground is a potentiometer 6, such that the amount of voltage flowing through circuit connections common to such source can be controlled as desired.

At 7 is a voltage distributing system comprising bus-bars 8, the total number of which is the same as the total number of switches in any set of switches of the playing-keys. Each bus-bar has electrical connection at 20 with a circuit lead 21, the latter having terminal contacts 22 and 23. For each set of switches 3 of any playing-key there is thus provided a corresponding number of contacts 22 which are open circuited relative to said switches when the key is elevated. As each contact 22 is individual to a particular switch 3 of a playing-key and as each switch 3 connects with a particular one of said alternating voltage sources, it follows that when the key is depressed, the circuits between respective sources and different bus-bars will be closed and voltages of different tone frequencies impressed upon assigned ones of said bus-bars.

The stops 24 herein shown are each provided with a set of ten switches 25, the switches of each set being common to an associated set of contacts 23 of the circuit leads 21, and as shown, each said switch has an output circuit connection 26 provided with a resistor 27 in series therewith, the connection being tapped to an intensity grading resistor 28. Said intensity grading resistor connects to ground and is adapted to be coupled to the input circuit of an amplifier, not shown. In each bus-bar 8 is a resistor 29 which provides a constant leak to ground.

The upper playing-key 2 is assigned to the note C2 and the lower key to the note C3. The key switches 3 of the set for note C2, reading downward in said set will respectively have conducted thereto alternating voltages of the tone frequencies of notes C1, C2, G2, C3, G3, C4, E4, G4, A#4 and C5. The switches 3 of the set for note C3 will respectively have conducted thereto alternating voltages at the tone frequencies of notes C2, C3, G3, C4, G4, C5, E5, A#5 and C6.

It will suffice to say that upon drawing the upper stop 23, the first and second switches 25 from the top of the set employed thereby will conduct alternating voltages to tap 100 of the grading resistor 28 from sources C1 and C2, the former supplying alternating voltage corresponding to the subpartial of the fundamental frequency

quency C2. The third switch from the top of the set will conduct voltage to tap 200 from source G2. The fifth switch conducts voltage to tap 300 from source G3. The sixth switch conducts voltage to tap 400 from source C4 and the eighth switch conducts voltage to tap 400 from source G4. Thus upon drawing said stop, components C1, C2, G2, G3, C4 and G4 will be synthesized into a complex waveform corresponding to the tone quality denoted by said stop. As key 2, assigned to note C3 has its switches similarly tapped to the resistor 28, it hardly is necessary to trace the circuits in detail as my invention can now be readily understood by persons trained in the art to which it relates.

Fearing in mind that the impedance of each of the aforementioned alternating voltage sources is different from that of any of the others in the set employed and that a variable impedance is connected across the output of each said source, reference can now be had to Figure 1 of the accompanying drawings for a more complete understanding of the purpose of my invention. In said figure, 96 impedances are illustrated and arranged in identical groups of twelve impedances each. Each of said groups is distinguished from any other group in the series by a number which indicates the octave position of the group in the gamut. Each of the impedances is variable from zero to approximately the maximum output of the source to which it is connected.

Assuming that 96 individual alternating voltage sources are embodied in the instrument and that each source supplies alternating voltage corresponding to the fundamental tone frequency of a particular note in the equally-tempered musical scale, it now is required that the amount of voltage taken from each source be regulated and made accurately such as will insure faithful reproduction of tones at an electrical sound producer to which the different partial frequencies are adapted to be conducted from an amplifier in the output of the herein disclosed synthesizing system.

In Figure 5 of the drawings it is assumed that each of the impedances 6 is situated at the voicing panel 10 disclosed in Figure 1. The numerical exponents of each of the lettered alternating voltage sources disclosed in Figures 2 and 5 are indicative of the positions in the scale of the various notes, i. e. in each of said figures, C1 denotes note C in the first octave; C2, the same note an octave higher; and throughout for all the C notes; E4, the note E in the fourth octave; E5, the note E an octave higher; G2, the note G in the second octave, G3, the same note an octave higher; G4 the same note an octave above G3; G5, the same note an octave above G4; A#4, the note A# in the fourth octave, and A#5 the same note an octave above A#4, and so on, throughout the gamut depending upon the octave range of the instrument.

With the above description in mind, it manifestly follows that with the panel 10 disposed in back of the console or in some other readily accessible place in the console, the voicer, may sound each note separately and by a simple adjustment of an associated impedance at the panel, can control the amount of voltage desired to be conducted through all branch output circuits which are common to the same source. In

this manner, the instrument can be correctly voiced and the amount of alternating voltage from each source controlled in a manner whereby when preselected voltages at predetermined relative intensities are amplified, thence converted into audible sound, the resultant waveform will be typical of the tone quality of the instrument being simulated.

While I disclaim as my invention the aforementioned electrical network per se, I claim either the identical network or its electrical equivalent in combination with a system for centralizing the aforementioned adjustable impedance and enabling an associated alternating voltage source to be traced quickly and the amount of voltage drawn from said source controlled as desired. Said combination shall be both broadly and specifically construed and specifically shall include a panel insertable as a unit in said network and providing a common support for said impedances. It shall also broadly and specifically include a panel by which the impedances are coordinated with the alternating voltage sources in alphabetical and numerical orders indicative of the positions of the notes in the gamut.

What I claim as my invention is:

1. In an electrical musical instrument employing a key manual, a plurality of generators of alternating current at the tone frequencies of notes associated with different keys of said manual and key-controlled circuit paths for selectively delivering output current from respective generators to the input circuit of an amplifier, the combination of an assembly of individually adjustable voltage regulators for said generators, said assembly of voltage regulators comprising one such regulator for and connected with each individual generator for determining the voltage of output current delivered to said input circuit from said generator, said regulators of said assembly of regulators being classified in the numerical order of the different octaves of said manual and in the alphabetical order of notes in each of said octaves, and means for mounting said assembly of regulators upon and for rendering same accessible from exteriorly of the case of said instrument.

2. In an electrical musical instrument employing a key manual, a plurality of generators of alternating current at the tone frequencies of notes associated with different keys of said manual and key-controlled circuit paths for selectively delivering output current from respective generators to the input circuit of an amplifier, the combination of adjustable impedance elements for said generators and comprising one such element for and connected across each individual key-controlled path and in shunt to ground, and means classifying said impedance elements in the numerical order of the different octaves of said manual and in the alphabetical order of notes in each of said octaves and for mounting said elements upon said instrument for individual adjustment of said elements according as the voltage of output current delivered by a particular generator of said plurality of generators is desired to be regulated relative to that of the output current delivered by another generator of said plurality of generators.

VALENTINE J. MOHLER.