July 31, 1951 J. A. KOEHL 2,562,670

MUSICAL INSTRUMENT

Filed April 22, 1949 5 Sheets-Sheet 1

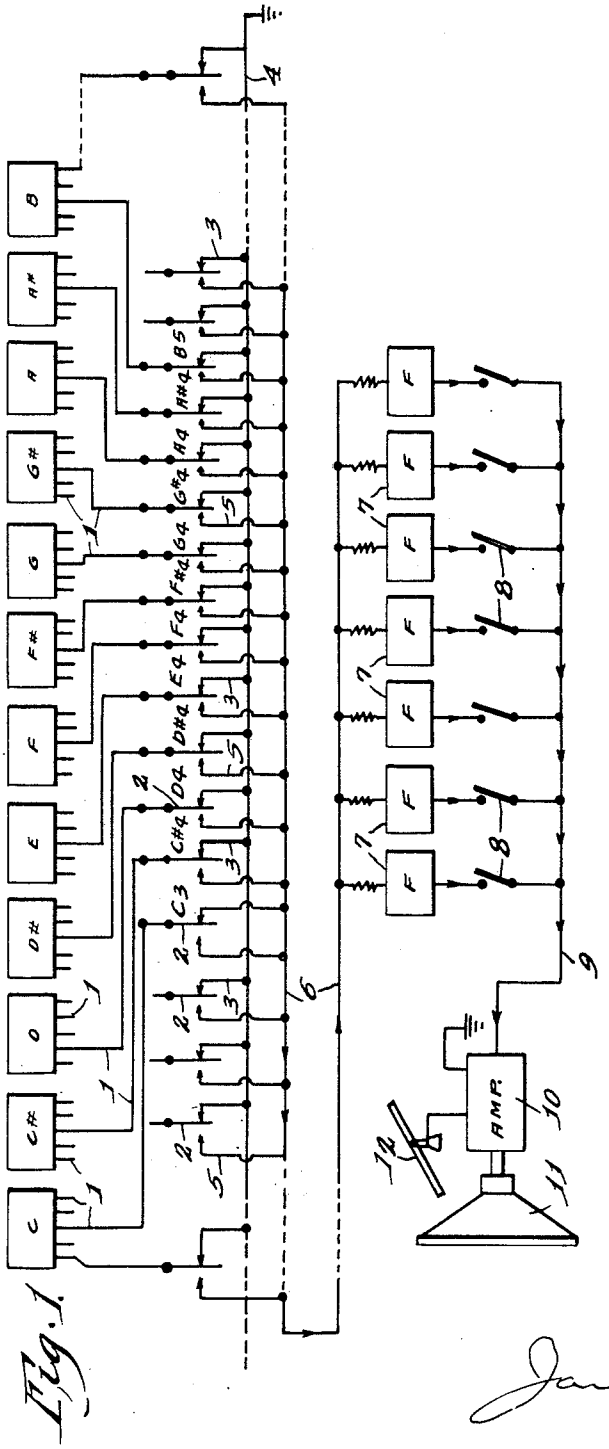


Fig. 1.

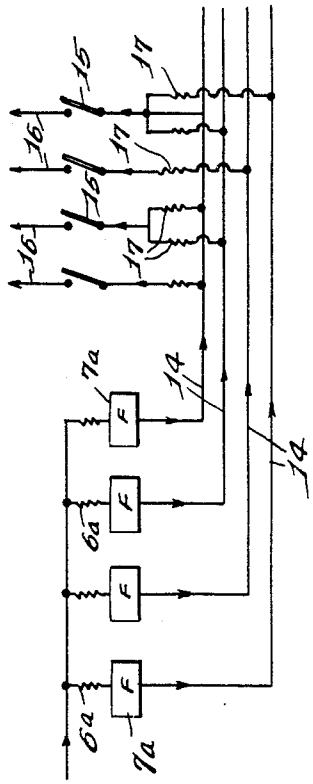


Fig. 2.

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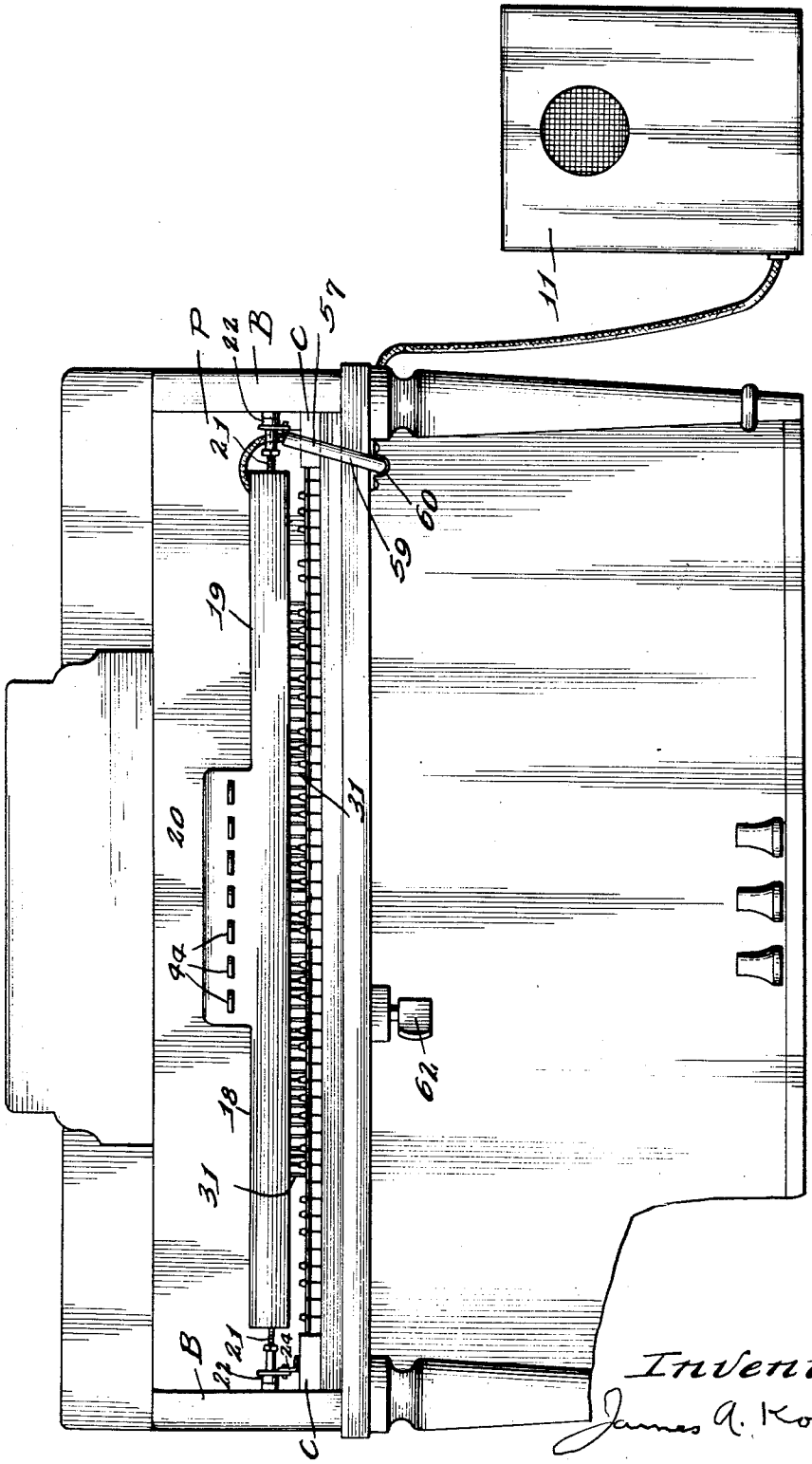


Fig. 3.

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Fig. 4.

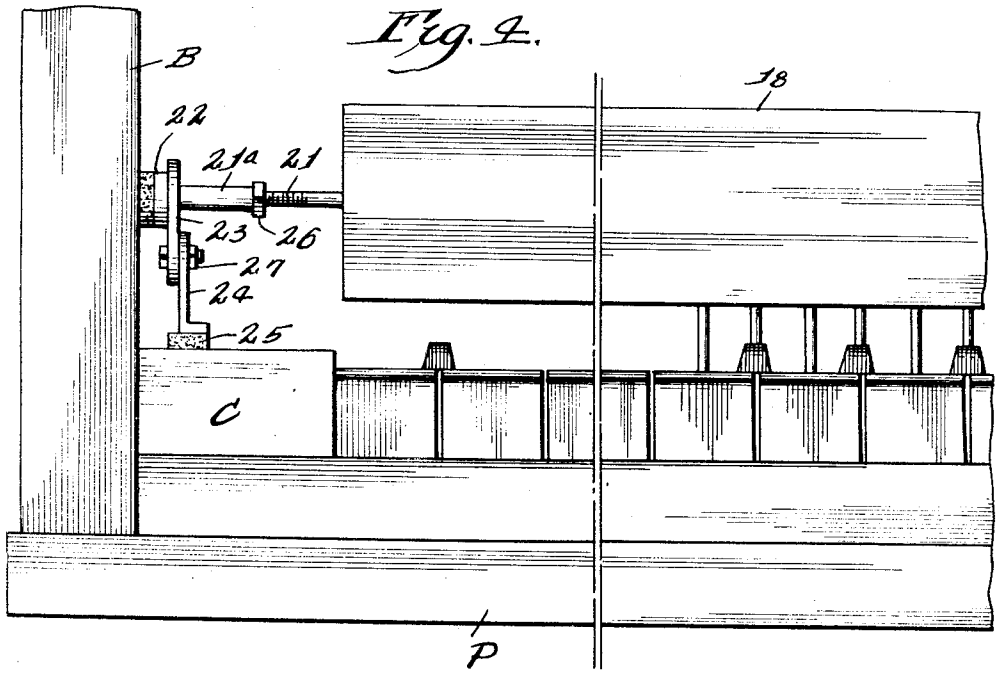


Fig. 6.

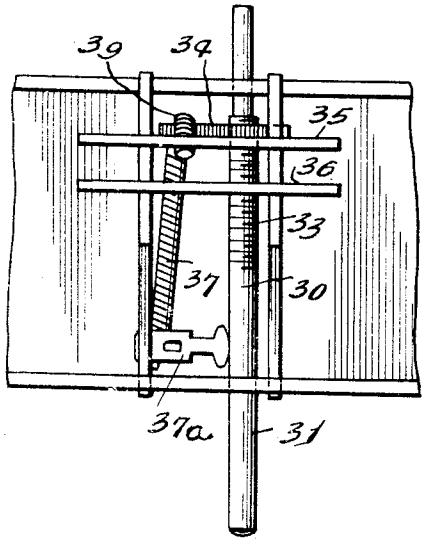
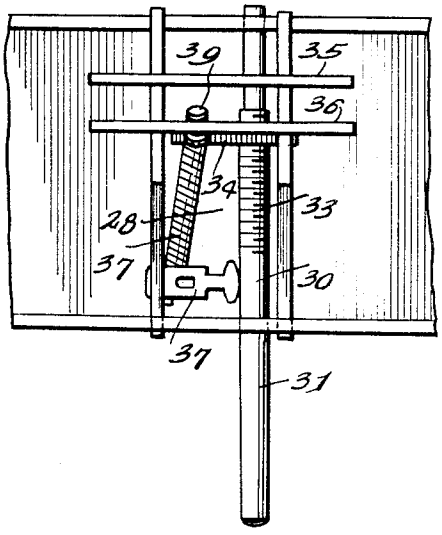


Fig. 7.



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Fig. 10.

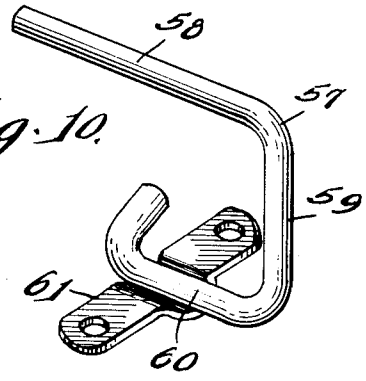


Fig. 5.

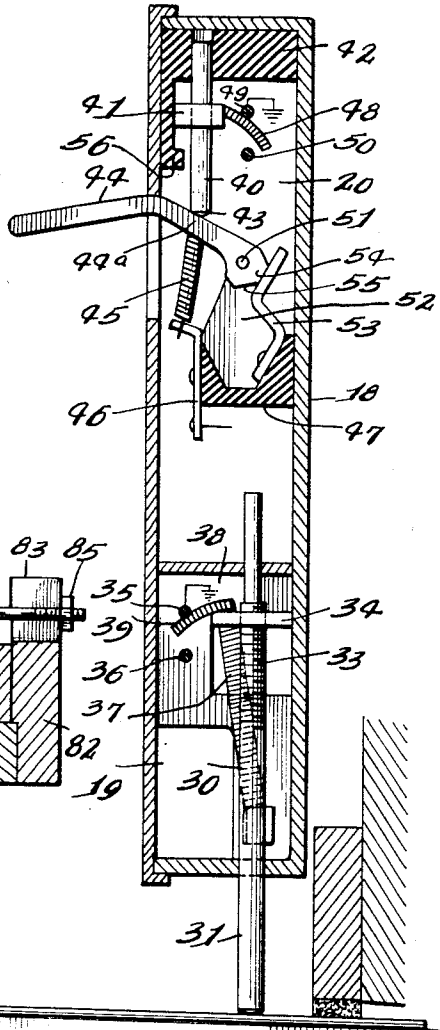
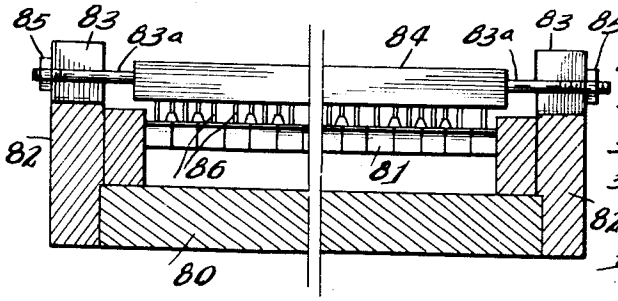
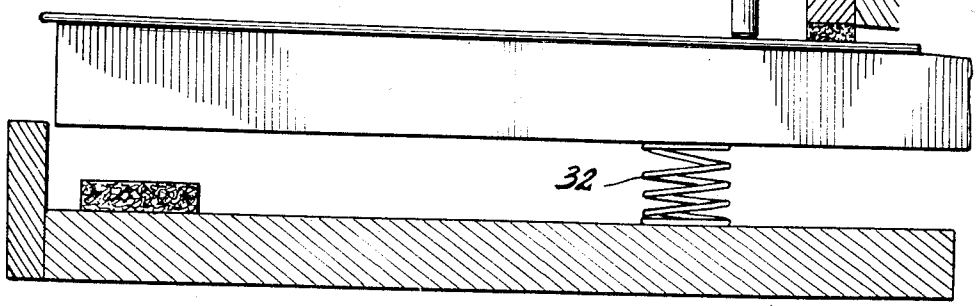


Fig. 11.





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Fig. 8.

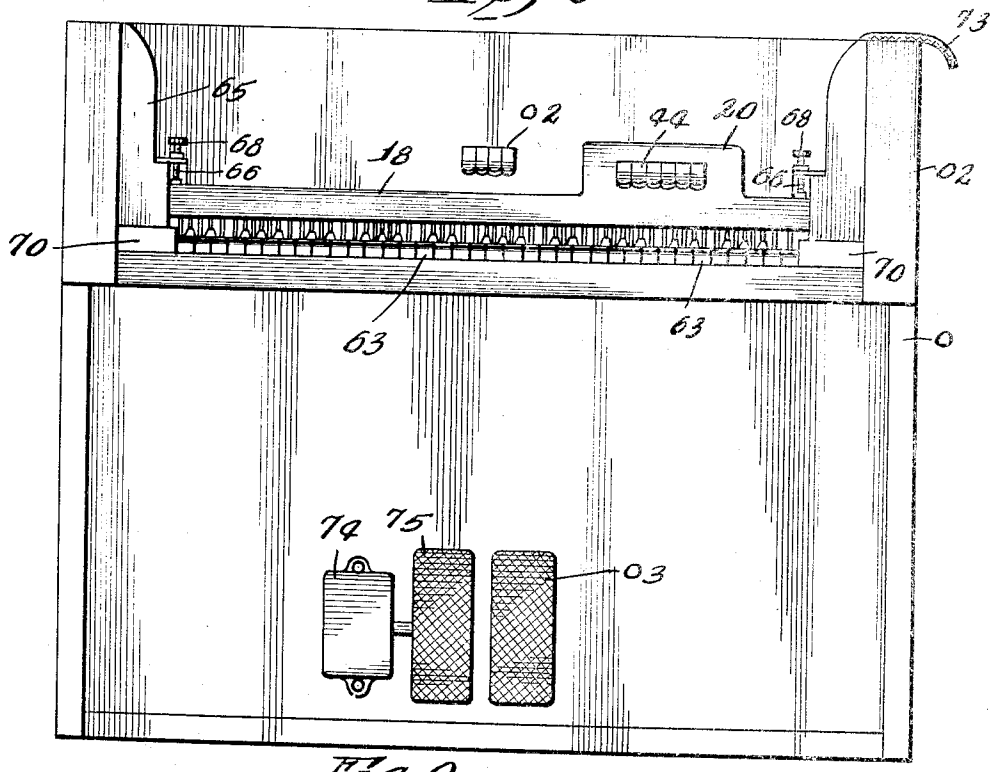
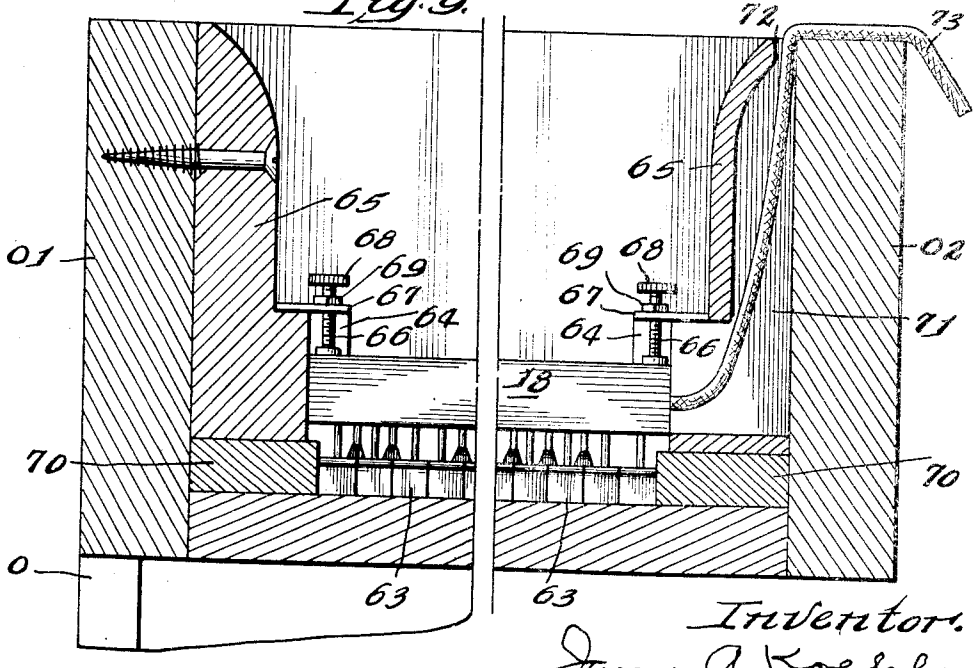


Fig. 9.



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Patented July 31, 1951

2,562,670

UNITED STATES PATENT OFFICE

2,562,670

MUSICAL INSTRUMENT

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Application April 22, 1949, Serial No. 89,123

16 Claims. (Cl. 84—1.11)

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This invention relates to musical instruments and broadly to a readily portable organization of elements for electrically producing organ and orchestral tones from the playing-keys of any conventional keyboard.

The invention relates more specifically to an attachment for keyboard musical instruments such as pianos, pipe, reed and electric organs or other keyboard musical instruments for the production of sustained musical tones of any selected timbre from the instrument's keyboard, which said tones can be played singly or in ensemble with tones produced by mechanism typical of said instrument.

The invention is also directed to certain improvements in the invention disclosed and broadly claimed in my prior Patent No. 2,250,065 of July 22, 1941. The invention disclosed in said patent embodies electric switches which are coactive with respective playing-keys of a piano or other keyboard musical instrument for selective activation of electronic devices with resultant production of organ-like tones. In a broader sense and as distinguished from the device disclosed in said patent, the herein disclosed invention may or may not be used with any inexpensive and readily portable keyboard which is not necessarily a part of a musical instrument and is used solely in combination with the control mechanism for producing musical tones from said keyboard.

The herein disclosed invention is essentially characterized by structural features enabling quick and convenient attachment thereof to any conventional keyboard or to the keyboard of a piano, pipe, reed or electric organ or any other keyboard instrument without any necessity for making structural changes in the case or console of the instrument, and in like manner, removed therefrom and readily carried from one place to another as and when desired.

Further objects and advantages of the invention, are:

(*a*) The provision of a device which can be attached to any conventional keyboard for producing sustained tones in response to playing any selected playing-keys of said keyboard.

(*b*) The provision of a device adapted to be supported upon the case or console of any keyboard musical instrument and correctly related to the keyboard and maintained in fixed relation to the keyboard to prevent accidental derangement thereof.

(*c*) The provision of a compact attachment, the control mechanisms of which are readily accessible to the player.

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(*d*) The provision of a device, which, when combined with another keyboard musical instrument will enable tones produced thereby to be mixed and played with tones produced by the instrument's customary sound producing mechanism.

(*e*) The provision of a device which, when attached to many makes of pipe, reed and electric organs will provide same with additional voices and thereby greatly increase the musical possibilities and advantages thereof.

(*f*) The provision of an inexpensive, light weight and readily portable device of attractive appearance.

Other objects and advantages will appear from the following description and upon reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a suitable electric circuit which may be employed in carrying the invention into practice;

Figure 2 is a view similar to Figure 1 of a further form of useful circuit;

Figure 3 is a front view of a piano showing the device attached thereto;

Figure 4 is a view partly in section and partly in elevation of a portion of a piano and a portion of the attachment, illustrating in detail the means for enabling both longitudinal and vertical adjustment of the switch assembly and for securing the assembly to the case of the piano;

Figure 5 is a section taken approximately on line 5—5 of Figure 3;

Figure 6 is a view in elevation of one of the electric switches, showing same in an "off" position;

Figure 7 is a view similar to Figure 5, showing the switch in an "on" position;

Figure 8 is a view in front elevation of an organ showing the invention attached thereto;

Figure 9 is a view partly in section and partly in elevation showing in detail the means for adjustably mounting the key assembly over the keyboard of the organ shown in Figure 7;

Figure 10 is a perspective view of the cable attaching means employed in the embodiment shown at Figure 3;

Figure 11 is a vertical section through a portable structure embodying a conventional keyboard showing my key assembly applied thereto.

The herein disclosed invention may employ, in combination with electric switches, most any well known form of electronic mechanism for producing sustained musical tones of any selected timbre. Reference is made to the invention disclosed in United States Letters Patent to Larsen,

No. 2,403,090 of July 2, 1946, in which patent audio signals at the tone frequencies of given notes of the chromatic scale are produced by vacuum tubes. These vacuum tubes may be connected in cascade, such as shown in United States Letters Patent to Larsen et al., No. 2,410,883 of November 12, 1946. In this patent, there would be twelve sets of vacuum tube oscillators in which the frequencies generated by successive stages of each separate set are octavely related. In the herein disclosed embodiment of my invention, there will be twelve sets of oscillators in which the oscillators are connected in cascade and the frequencies of said oscillators controlled so that there would be a set of oscillators for all C notes, a set for all C# notes, a set for all D notes, etc. to and inclusive of a set producing octavely related frequencies for all B notes. These generators are connected in circuit with respective electric switches, a wave filter system and an electro-acoustical system for the conversion of selected tone frequencies into audible sounds of any selected timbre.

As the primary purpose of the present invention is the provision of a simple and inexpensive organization of elements adapted for use in combination with most any keyboard instrument, it is necessary that the mechanisms comprising same shall fulfill their purpose in a highly dependable manner and that the device shall be applicable to a great number of keyboard instruments in general use.

At Figure 1 is shown in block diagram twelve sets of vacuum tube oscillators lettered C, C#, D, D#, E, F, F#, G, G#, A, A# and B. Each separate set of said oscillators has its oscillators connected in cascade which may be accomplished either in the manner set forth in said Larsen et al. patent, No. 2,410,883 or by any other well known circuit in which a first oscillator operating at a given frequency is coupled in cascade with a plurality of slave oscillators, the respective oscillators of each cascade providing octavely related complex wave forms. When my invention is used in combination with a piano it will ordinarily provide sixty complex tone frequencies respectively corresponding to the vibration frequencies of notes C2—B5 of the keyboard of the piano. However, this may be departed from and in some instances, oscillators producing wave forms at the tone frequencies of all the eighty-eight notes of the piano will be provided. It suffices to say that at Figure 1 each cascade of oscillators provides five output leads 1.

At said Figure 1 is shown an assembly of playing-key actuated electric switches. In practice, there will be one of these switches for each playing-key of the piano keyboard producing tones at said vibration frequencies C2—B5. To avoid complicating the circuit only a few of the total number of said switches are shown. Only twelve of them are connected to respective frequency sources, namely, switches respectively coactive with playing-keys associated with notes C3—B3. As each separate cascade produces only five complex octavely related frequencies, then, and assuming that the first stage produces the highest frequency, we can assume that the lead 1 in the middle of the five leads running from each separate cascade is from the third oscillator of said cascade, such that the middle lead 1 from cascade C furnishes switch C3 with an audio signal corresponding to the vibration frequency of note C3. Similarly, the middle output lead 1 from cascade C# supplies C#3 with an audio signal corresponding to the vibration frequency of note C#3, and so on to and inclusive of the middle output lead 1 from cascade B which furnishes an audio signal to switch B3.

Each of the aforementioned key actuated switches comprises a movable contactor 2 connected with a respective lead 1, a fixed contactor 3 connected to ground 4 and a fixed contactor 5 connected to a common output conductor 6. When the playing-keys are elevated their coactive movable switch contactors 2 engage the fixed contacts 3 and the oscillators are grounded. When any key is depressed, the movable contactor moves into engagement with its coactive fixed contact 5 and the signal flow is from a respective oscillator to said common conductor 6. Wave filters 7 have their input sides connected to said common conductor and, as shown, the output side of each filter is provided with an electric switch 8, which, when close circuited, as desired, causes the output wave from said filter to be impressed on a conductor 9 connected with the input circuit of an audio frequency amplifier 10, in the output circuit of which is a loud speaker 11. Said amplifier is equipped with a volume control device 12. It follows that as the output wave from any oscillator of the cascaded sets of oscillators is rich in harmonics, these waves will be repeated in the outputs of said wave filters as waves, certain of the upper harmonics of which have been suppressed. A filter system capable of functioning in this manner is disclosed in the aforementioned Larsen Patent No. 2,403,090. When a circuit functioning as aforestated is used in combination with a pipe, reed or any well known electric organ, the wave form in the output of any filter can be converted into audible sound at any desired amplitude and can be played in ensemble with tones of any selected timbre produced by the frequency or vibration producing means of said organ. Tones produced either by the organ or the mechanism of the disclosed attachment, can also be played separately. By reason of the wave filters, the complex output waves from the oscillators can be converted into substantially sinusoidal waves or waves less complex than those produced by said oscillators. In this manner, an organ, the tones or voices of which are wholly reedy can, by the method and means herein employed be provided with simple and dependable sources from which a great variety of orchestral and organ-like tones are available as desired. By this method, inexpensive organs now in use and having only a very limited number of voices can be brought to a high standard of development and by a simple and inexpensive organization of elements capable of application to most any organ in a minimum of time. Even expensive organs can be materially improved by addition thereto of the herein disclosed invention. Particularly is this true in those instances where an organ lacks certain solo voices, which, if added to an organ would necessitate costly installation of many pipes and/or reeds and other bulky space consuming accessories.

An alternative form of circuit is shown at Figure 2. In this embodiment of my invention, the output conductors 6*a* from the keying switches (not shown) are connected to the input sides of wave filters 7*a*. The outputs from these filters connect with respective bus-bars 14. Signal voltages impressed on these bus-bars are adapted to be impressed on the input circuit of a power amplifier (not shown) via circuit leads 16. A circuit of this character is also disclosed in said Larsen Patent No. 2,403,090. In many respects

this circuit is superior to the circuit shown at Figure 1 in that the output waves from different bus-bars 14 can be brought together through branch resistive paths 17 such that the wave from one bus-bar can be of a different amplitude than the wave taken off of another one of said bus-bars. For the better installations, this method, while more costly than the method shown at Figure 1, enables producing at a given stop 15, a wave which is the sum of two or more waves from different filters.

Referring now to the form of my invention shown at Figure 3, the attachment comprises a rectilinear housing 18 embodying a lower section 19 and an upwardly extending medial section 20. Said housing can be of any appropriate length depending upon the total number of tone sources employed and the number of electric switches intended to be connected in circuit therewith. The piano P may be of any conventional make and, as shown at Figures 3 and 4, the housing is vertically disposed and lies at the extreme back ends of the effective playing-surfaces of the playing-keys of the instrument's keyboard, the thickness of the housing or dimensions from front to back being approximately one-half inch so as not to interfere with motion of the fingers over the playing-keys. The end portions of the housing have projecting therefrom horizontally disposed threaded rods 21, each provided with an internally threaded longitudinally adjustable sleeve 21*a*, the outer end of which terminates in a flat felt faced clamping disk 22. Mounted to turn freely on each rod is a metallic member 23 which is provided with a vertically adjustable foot 24 whose lower face is felted as at 25. On each rod 21 is a nut 26. When attaching the housing to the piano, it is placed vertically at the rear of the playing-keys and when an operative relation of the housing to the playing-keys is established, the sleeves 21*a* are turned so as to advance the disks 22 firmly against the inner surfaces of the side pieces B of the case of the piano. The foot pieces 24 are brought to rest on the upper surfaces of the cheeks C of said case and are secured in fixed positions of vertical adjustment by clamp nuts 27. Clamp nuts 26 on rods 21 are then firmly adjusted against the inner ends of sleeves 21*a*. The structural features just described permit both longitudinal and vertical adjustment of the switch housing, the purpose for which will be manifest as the description proceeds.

At Figures 5, 6 and 7 are shown the electric switches 28 of the assembly of switches which are coactive with respective playing-keys of the piano keyboard, and the stop switches which are contained in the medial portion of the housing. In each case, the switches are arranged in longitudinal rows.

The playing-key actuated switches may be of the form and construction disclosed in the patent to Larsen et al. No. 2,484,977, November 15, 1949. These switches each essentially consist of a pin 30 mounted in portion 19 of the housing for free sliding motion vertically and provided with a downwardly projecting portion 31 which extends sufficiently below the bottom of the housing to enable its lower end to rest on the playing surface of a respective playing-key, so that by the normal upward tension of spring 32 on the playing-key, both the key and the pin are urged upwardly, the pin to an "off" position of the switch and the key to a fully elevated position. Inwardly of the housing section 19, the pin 30 is threaded at 33 for coaction with a traveling nut

34 of hard insulating material. 35 and 36 are respective bus-bars, and, as shown, a coil spring 37 of suitable light gauge silver wire has its lower portion electrically connected to a clip 37*a* to which an output terminal 1 from a respective tone frequency source is adapted to be connected. Bus-bar 35 is grounded at 38 and when pin 30 is elevated, a reduced portion 39 of coil spring 37 engages same. The spring, by reason of its attachment to said clip and to nut 34 tends normally to urge the pin in a downward direction, thereby enabling the pin to follow the playing-key as the latter is being depressed, such that when the key is lowered the small upper extension 39 leaves the bus-bar 35 and engages bus-bar 36. The pins 30, of which there are sixty in the described embodiment of my invention, are spaced apart longitudinally a distance enabling each separate pin to make free contact with a respective playing-key as shown at Figure 3.

The stop switches of which only one is shown at Figure 5, comprises a free vertically sliding pin 40 provided with a lug 41 of hard insulating material. The pin is slidable in an insulating block 42 situated in the portion 20 of the housing. Its lower end is rounded at 43 and rests freely on the cam 44*a* of a stop tab 44. Coactive with the pin is a coil spring 45, the lower end of which is soldered to a terminal clip 46 secured to a fixed block 47 of hard insulating material. The reduced upper coil 48 of spring 45 is secured to lug 41 and has its free extremity projecting between a grounded bus-bar 49 and an output bus-bar 50, the former of which has engagement with said reduced upper portion 48 of the spring. In this position of the parts, tab 44 is in its raised position. The inner end of the tab has the extremity of its cam 44*a* pivoted at 51 to an extension 52 of block 47. Block 47 has a flat leaf spring 53, the free end of which is coactive with the angular faces 54 and 55 of said cam 44*a* so as to hold the tab in any position of angular adjustment.

When the stop switch is "off" tab 44 occupies the position shown at Figure 5. Pin 40 has moved upwardly where the portion 48 of the contact spring engages the grounded bus-bar 49. Spring 53 retains the tab in this position. Current flow is from clip 46, through the spring 45 and to ground through bus-bar 49. When the tab is depressed, the pin 40 follows the motion thereof and rides said cam 44*a*, thus compelling portion 48 of the spring to approach and electrically contact bus-bar 50. Motion in this direction is limited by engagement of lug 41 with a stop 56 on block 42. The switch is then in an "on" condition. The current flow is then from terminal 46, through spring 45 and to the power amplifier via bus-bar 50.

All lead wires to and from the playing-key switches and the stop switches are formed into a cable which is strung in the lower portion of the aforementioned switch housing. The free end of the cable extends from one end of the housing and preferably through a cable attaching tubing 57. This tubing has a long leg 58 which rests on the adjacent cheek of the case of the piano, a depending portion 59 which lies in front of the piano, and a short rearwardly extending leg 60 which underlies the bed plank and is secured thereto by a strap 61.

The expression control device 62 (Figure 3) is preferably situated to the left of the vertical center line of the switch housing and secured to

the bed plank so as to be readily actuable by the knee of the player.

At Figures 8 and 9, the invention is shown applied to an organ. For the purpose of the invention the organ may be one in which tones are produced either by pipes, reeds or by any well known electrical system employing frequency generators for producing wave forms that are adapted to be converted into audible sounds for musical expression. One such system is disclosed in the aforementioned Larsen patent, No. 2,403,090. Another form to which the invention is applicable is disclosed in the Hammond patent, No. 1,956,350. In Figure 8, the attachment which is identified by the same reference numerals as used in the first described embodiment of the invention is mounted over the keyboard 63 of the organ O. In this case, the invention employs a slightly different type of switch housing and mounting means. In the form of the invention first described, the same is used with an instrument having 88 playing-keys. The normal note compass of an organ is five octaves. For this reason, though it will not follow in all instances, the switch housing is substantially coextensive with the keyboard. Its ends are mounted in vertical guide waves 64 formed in blocks 65 so as to be adjustable vertically. Switch housing 18 is provided with adjusting screws 66 movable through fixed plates 67 and provided with knobs 68. By turning the knobs in the plate 67 and by swiveling the lower ends of the screws 66 to the housing, the latter can be raised and lowered as desired and the contact pins of the switches operatively related to their respective keys. When a necessary adjustment has been made, jamb nuts 69 on the screws are advanced against the plates 67 so as to hold them against retrograde. Blocks 65 may be secured to the inner faces of the side pieces O1 of the console of the organ, their lower ends terminating at the upper surfaces of the customary cheeks 70. The block 65 at the right of Figure 9 is hollowed out as at 71, the hollow portions communicating with one end of the switch housing and, as illustrated, the upper end of this hollow portion is open as at 72. This enables the cable 73 from the various switches to be concealed, except at the point where it is passed over an adjacent side O1 of the console.

In this embodiment of the invention, the portion of the housing which extends upwardly and accommodates the stop switches and control tabs is disposed to the right of the stop tabs O2 of the organ. This is a detail that is provided for the sake of convenience and accessibility of all stop tabs to the player. In some types of organs, the position occupied by the stop tabs of the attachment will be different. Also in this embodiment of the invention, the volume control device 74 preferably includes a pedal 75 disposed in close proximity to the expression pedal O3 of the organ. When using an organ embodying my attachment, voices obtainable either by the attachment or by the organ can be played separately or together as desired. When mixing an electronically produced tone with a tone produced by pipes or reeds, there is an advantage not heretofore possible with other organs, namely, that there can be mixed with the tone produced by the organ a tone produced by the attachment in which most any shading in the amplitude thereof can be controlled. There are many instances when playing an organ that only a negligible amount of a tone of one timbre is necessary to be mixed with a tone of another timbre in order to give a more or less correct mixture. This can be accomplished with unusual nicety by the means employed herein. I stress particularly an attachment for most any type of organ which can be used in conjunction with the keyboard and will contribute to the organ innumerable devices that heretofore would have been costly to install in either a pipe or reed organ. I further stress that feature of the invention which enables the device to be attached readily and is portable, inexpensive and when attached will not in any manner interfere with the normal playing of an organ. While I have shown a single manual, the invention is in no manner limited in this respect. Similar attachments can be applied to as many manuals as desired. In each case, the individual attachments would have individual volume control devices.

Among other novel features, I particularly stress the feature which comprises a switch assembly that can be quickly attached to and removed from a keyboard and when attached and the switch actuating pins of the switches correctly coordinated with the respective playing-keys, the assembly will be capable of resisting any manual force that may be applied thereto in any direction when the keyboard is played or when force, either in a downward or an upward direction is applied as can result when manipulating the stop tabs 44. In the absence of means for preventing derangement of the switch assembly, tilting of the assembly from an intended horizontal position could result in an accidental close circuiting or partial close circuiting of the playing-key-actuated switches with the result that output tone signals from the various oscillators will be effective in the network such that unwanted sounds would be heard at the loud speaker 11.

I have shown and described an assembly of key operated electrical switches disposed above the keyboard of an organ. This is because of the great number of organs in use and not that there is an intention to limit the invention in this respect. Pipe organs have certain acknowledged advantages over electric organs. Electric organs have certain acknowledged advantages over pipe organs, such for example, their ability faithfully to produce many orchestral tones by relatively inexpensive methods, devices and mechanisms that require only a minimum of space for their accommodation. Except for the swell boxes of a pipe organ, all tones speak at the same intensity and it is impossible to reduce the sound level with that nicety that is characteristic of electronic instruments in which the volume of produced sound can be reduced almost to a whisper. Thus, it follows that any pipe or reed organ can be greatly improved by addition thereof of the herein described improvements.

The playing-key supporting springs, one of which is shown at Figure 5, are such that the resiliency thereof is sufficiently in excess of that of the springs of the keying switches as to effectively lift the pins when pressure is removed from the keys, thereby restoring the switches to open circuited conditions in exact time with manipulation of the keys.

At Figure 11, a portable structure 80 consists of means such as a case having a conventional keyboard 81. The case has its ends 82—82 formed with vertical slots 83—83. The key switch and mixer assembly 84 are the same as the form shown at Figure 4, except that threaded rods

project from the opposite ends of the assembly housing and are accommodated in the respective slots 83—83 for vertical adjusting and are provided with clamp nuts 85 adapted to be brought into clamping engagement with the outer faces of said ends 82—82 to secure the housing in a position of vertical adjustment where the playing-key actuated pins 86 will be operatively related to the respective playing-key of the keyboard.

What I claim as my invention is:

1. An attachment for keyboard musical instruments of the class employing a case and means actuable by each separate playing-key of the keyboard of said instrument for producing a musical tone having the vibration frequency of a given note of a musical scale, said attachment comprising an assembly of longitudinally spaced apart electric switches disposed for actuation by respective playing-keys of said keyboard in response to application of playing pressure to and removal of same from said keys, means for detachably mounting said switch assembly on said case for adjustment to vertically aline different switches of said assembly with respective ones of said keys and for securing said assembly in a position of fixed adjustment, each of said switches including an actuator which is vertically adjustable relative to the playing-surface of a respective playing-key and means responsive to actuation of said switches when playing said keys for producing musical tones having the vibration frequencies of notes associated with said keys.

2. An attachment as set forth in claim 1 wherein said mounting means comprises devices on said switch assembly engageable with portions of said case at the respective ends of said keyboard.

3. An attachment as set forth in claim 1, wherein said mounting means comprises devices carried by said switch assembly at the respective ends thereof for clamping engagement with portions of said case at the respective ends of said keyboard.

4. An attachment as set forth in claim 1, wherein the switch assembly includes a longitudinal housing disposed above said keyboard at the back ends of the playing-keys and wherein the mounting means includes devices at the respective ends of said housing, for engagement with portions of said case at the respective ends of said keyboard.

5. An attachment as set forth in claim 1, wherein said mounting means includes extensible devices carried by said switch assembly at the respective ends thereof for fastening said assembly to said case at the respective ends of said keyboard.

6. An attachment as set forth in claim 1, wherein means are provided for coaction with said switch assembly and said case for positively preventing vertical movement of said assembly when said assembly has been adjusted to establish the aforementioned relation of said switches to said respective playing-keys.

7. An attachment as set forth in claim 1, wherein said mounting means is provided with means engageable with said case for preventing vertical movement of said switch assembly when said assembly has been adjusted to establish the aforementioned relation of said switches to said respective playing-keys.

8. An attachment as set forth in claim 1, wherein said mounting means comprises longitudinally extensible devices at the opposite ends of said switch assembly for clamping engagement with adjacent portions of said case.

9. An attachment as set forth in claim 1, wherein an enclosure is provided for said switch assembly and includes an upper extension containing a selectively actuable, hand operated mixer with stop control devices disposed in front of the extension, and wherein means are provided for coaction with said case to resist force in a downward direction when actuating said stops and prevent downward movement of the switch assembly from an established position of adjustment thereof.

10. The combination with a piano and means for electrically generating audio signals at the tone frequencies of notes associated with given playing-keys of the keyboard of said piano and for translating said signals into audible sounds for musical expression; an electric switch assembly removably connected with the piano at the respective ends of and disposed above said keyboard at the back ends of the playing-keys thereof, and embodying longitudinally spaced apart electric switches associated with and actuable by assigned ones of said playing-keys, and electrically connected to said signal generating means for translation of signals into audible sounds when depressing selected ones of said playing-keys, means enabling adjustment of the assembly respectively in longitudinal and vertical planes, and means for securing said assembly in a position of selected adjustment.

11. The combination with a horizontally disposed keyboard, each playing-key of which has pivotal motion about a horizontal axis, and means for electrically generating audio tone signals having the vibration frequencies of different notes of a musical scale with which different playing-keys of said keyboard are associated, of an organization of electric switches connected in circuit with said signal generating means, each separate switch of said organization of switches having an actuator which is yieldingly urged axially in a direction to lightly press against a respective key of said keyboard to follow pivotal motion of the key and thereby cause operation of the switch, and means for vertically aligning the actuators of given switches of said organization of switches with preassigned playing-keys of said keyboard and selectively adjusting the actuators vertically.

12. The combination with a horizontally disposed keyboard, each playing-key of which has pivotal motion about a horizontal axis, and means for electrically generating audio tone signals having the vibration frequencies of different notes of a musical scale with which different playing-keys of said keyboard are associated, of an organization of electric switches connected in circuit with said signal generating means, each separate switch of said organization of switches having an actuator which is yieldingly urged axially in a direction to lightly press against a respective key of said keyboard to follow pivotal motion of the key and thereby cause operation of the switch, and means coactive with said keyboard at the respective ends thereof for vertically aligning the actuators of given switches of said organization of switches with preassigned playing-keys thereof and adjusting the actuators vertically.

13. In mechanism of the class described, the combination with means embodying a horizontally disposed keyboard, each playing-key of which has pivotal motion about a horizontal axis, and means for electrically generating tone signals having the vibration frequencies of notes of a

musical scale with which different playing-keys of said keyboard are associated; of an organization of electric switches connected in circuit with said signal generating means, each separate switch of said organization of switches having an actuator which is yieldingly urged axially in a direction to lightly press against a respective key of said keyboard to follow pivotal motion of the key and thereby cause operation of the switch, means enabling adjustment of the switches as a unit relative to said keyboard, and means enabling individual adjustment of the actuator of any one of the aforementioned switches relative to a respective playing-key.

14. In mechanism of the class described, the combination with means embodying a horizontally disposed keyboard, each playing-key of which has pivotal motion about a horizontal axis, and means for electrically generating tone signals having the vibration frequencies of notes of a musical scale with which different playing-keys of said keyboard are associated; of a horizontally disposed rigid bar mounted for vertical and longitudinal adjustment relative to said keyboard and provided with playing-key actuated electric switches connected in circuit with said signal generating means and arranged in a longitudinal row above and at the back ends of the effective playing surfaces of said playing-keys and spaced apart from each other so that different ones of said switches are disposed for actuation by respective ones of said playing-keys, a system of electrical stop control devices carried by said bar and connected in circuit with said signal generating means, and means for securing said bar in fixed relation to said keyboard.

15. In mechanism of the class described, the combination with a case having a horizontally disposed keyboard; of means for electrically generating tone signals having the vibration frequencies of notes of a musical scale with which different ones of said keys are associated and for translating said signals into audible sounds, a

horizontally disposed rigid bar provided with playing-key actuated electric switches connected in circuit with said signal generating means and arranged in a longitudinal row above and at the back ends of the effective playing surfaces of said playing-keys and spaced apart from each other so that different ones of said switches are disposed for actuation by respective ones of said playing-keys, said bar being applicable as a unit to said case and being adjustable horizontally and vertically to establish and maintain a coactive relation of each separate switch to a respective playing-key.

16. In a musical instrument employing a case and a keyboard supported in a playing position by said case, means actuable from said keyboard for producing sustained musical tones in the pitch relation to notes of a musical scale with which respective playing-keys of said keyboard are associated, said means including a set of electric switches in which individual switches thereof are disposed for activation by said respective playing-keys; and a cable composed of tone signal input and output wires connected with said respective switches, said cables being substantially wholly concealed by structural parts of the case, except for a free end which extends externally thereof, as and for the purpose set forth.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,050,513	Barton	Jan. 14, 1913
2,045,172	Yungblut	June 23, 1936
2,201,232	Helberger	May 21, 1940
2,250,065	Koehl	July 22, 1941
2,403,090	Larsen	July 2, 1946
2,487,977	Larsen et al.	Nov. 15, 1949