

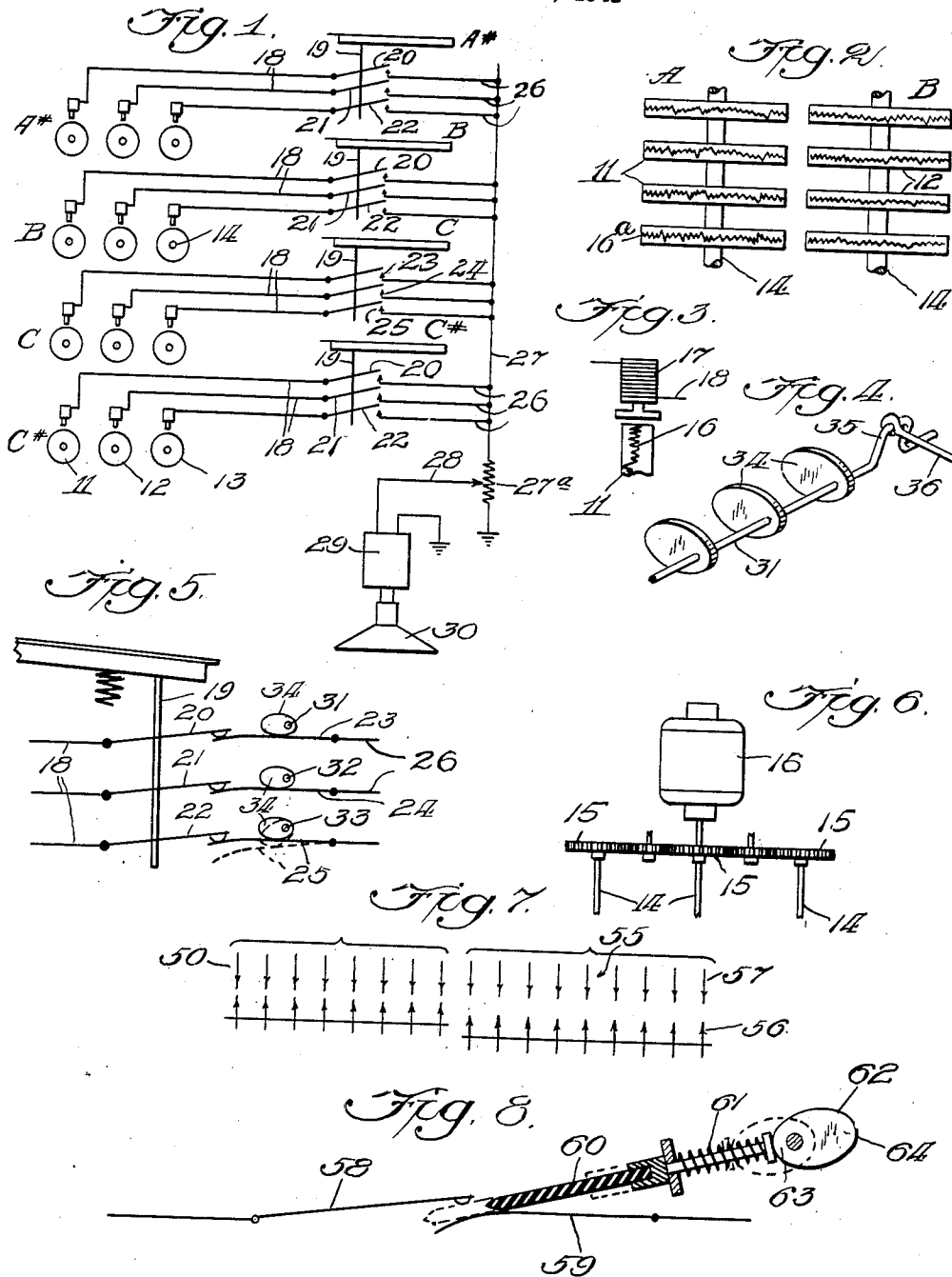
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2,327,720

MUSICAL INSTRUMENT

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MUSICAL INSTRUMENT

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This invention relates to electric organs of the class employing means for producing electrical oscillations of audible frequency in response to depression of selected playing keys.

The primary object of the invention is to simplify heretofore employed methods for electrically producing musical tones of different timbre.

Another object is to simplify heretofore existing methods for mixing together tones of different timbre.

A still further object is to provide a system of tone wheel generators in which all generators of said set are driven at the same speed, thereby eliminating the necessity of costly and complicated driving and driven gears heretofore employed for driving such generators, each at a speed which is different from that of any of the others of the generators of the system.

Another object is to simplify and greatly reduce the number of key contactors heretofore required in such instruments for rendering the oscillators effective upon a work circuit.

Another object is the provision of a greatly simplified system of stops for controlling production of selected timbres.

Another object is the provision of mechanism for producing a large number of timbres with a minimum number of tone generating sources.

A still further object is to eliminate from such instruments the complicated electrical networks heretofore required for handling and synthesizing electrical oscillations.

A still further object is to provide a system of stops and switches adapted to be used in an entirely new manner and with results never before obtainable in such instruments, said system being also useful in coaction with the playing keys of the instrument disclosed in my prior Patent No. 2,225,065 to enable tones of different timbre to be produced and selectively to render the tone generators electrically inactive when it is desired exclusively to produce piano tones.

A still further object is to provide simple and effective means enabling different timbres to be played from different parts of the keyboard of the instrument.

The novel features of my invention are set forth with particularity in the hereto appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will be fully understood from the following description of a specific embodiment,

when taken in connection with the accompanying drawing, in which:

Figure 1 is a schematic view of such portion of my invention as is deemed necessary for a clear and comprehensive understanding of the essential structural and functional features of the invention.

Figure 2 is a plan view of the means employed for producing electrical oscillations of audible frequency.

Figure 3 is an edge view of a portion of one of the tone wheel generators and its associated pick-up device.

Figure 4 is a perspective view of a portion of one of the cam shafts of my improved stop mechanism.

Figure 5 is a diagrammatic view of a set of key switches and associated cams.

Figure 6 is a plan view of the tone wheel driving mechanism, and

Figure 7 is a schematic illustration of a slightly modified form of key switches.

Figure 8 is a schematic view of a slightly modified form of stop mechanism.

In the accompanying drawing, I show playing keys A#, B, C and C# of a single manual. Any desired number of manuals may of course be employed, and the instrument will preferably have the customary pedal section. For each playing key there will be a plurality of pulsation generators 11, 12 and 13, each delivering an output potential having the tone frequency of the note associated with said key. While the frequencies of the output potentials of said generators 11, 12 and 13 are identical and correspond to the vibration frequency of the note associated with a respective playing key, the waveforms of the respective potentials are each thereof different from the other such, for example, that the waveform of output potential delivered by generator 11 will correspond substantially in every respect to a tone denoted by a predetermined stop of an organ, whereas the waveforms of output potentials of generators 12 and 13 will correspond to timbres denoted by other stops of the system of stops herein employed. For the purpose of a clear understanding of my invention it is assumed that the waveform of output potential from generator 11 has all the characteristics of the tone of an oboe; that the waveform of output potential from generator 12 has all the characteristics of the tone of the violin, and that the waveform of potential from generator 13 has all of the characteristics of the tone of the clarinet. I refer to these three tones merely to

show that for each individual playing key of the instrument there will be common thereto a plurality of waveforms of potentials, any one or any selected combination of which will be instantaneously available upon depression of the key according as selected stops are drawn. While only three such generators are shown in the instant example, there of course is no limit to the number that can be employed in actual practice. When three generators are provided for each playing key, any of the following single timbres or any desired combination of timbres can be elicited namely:

Full organ	{	Oboe
	{	Violin
	{	Clarinet
	{	Oboe and clarinet
	{	Clarinet and violin
		Oboe and violin
		Oboe, violin and clarinet

It follows that for each additional set of generators a proportionate increase in the number of various combinations of timbres will be available as will be appreciated upon reference to the following chart:

Full organ	{	Oboe
	{	Violin
	{	Clarinet
	{	Diapson
	{	Oboe and violin
	{	Oboe and clarinet
	{	Oboe and diapson
	{	Diapson and oboe
	{	Diapson and violin
	{	Diapson and clarinet
		Violin and clarinet
		Diapson, violin, clarinet and diapson

Assuming that the single manual herein disclosed has sixty-one playing keys, there will be a set of generators 11 comprising sixty-one individual generators; a set of generators 12 comprising sixty-one individual generators, and a set of generators 13 comprising sixty-one individual generators. Each separate set of said generators will continuously generate tone frequencies for the entire compass of notes of said single manual, and there thus will be common to each individual playing key three individual generators, the frequency of the output potential of which corresponds to the vibration frequency of the note associated with said playing key.

The generators of each set of said generators are fixedly mounted upon a single rotary shaft 14 provided with a driven gear 15 which forms a part of the common gear train shown in Figure 6. The shaft 14 of the generators 12 is preferably directly driven by a synchronous or suitable constant speed motor 16. As a result thereof, all of said generators 11, 12 and 13 of which there are one hundred and eighty three individual generators, will be driven at the same angular velocity.

Referring now to the individual generators 11, 12 and 13, each thereof preferably comprises a circular metallic disc of suitable diameter and thickness, the smooth peripheral surface 16a of which contains magnetically produced recordings of an actual pipe tone of predetermined pitch and timbre. Inductively related to the circular sound tract provided by said recordings, of each disc, is a pick-up magnet 17 having an output circuit lead 18.

The playing keys A#, B, C and C# in Figure

1 are each thereof provided with a sticker 19 having contactors 20, 21 and 22, provided with circuit leads 13 from respective generators of the transverse set of three generators 11, 12 and 13 common to a respective playing key. Springy contactors 23, 24 and 25 are disposed in electrical coaction with contactors 20, 21 and 22 of each playing key, and each said last mentioned contactor has an output lead 26 which connects with a common output conductor 27 provided with an adjustable potentiometer 27a, the movable element 28 of which connects with an amplifier 29 in a manner well known in the art. The amplifier is coupled to an electrical sound producer 30.

Upon referring to Figure 5, it is noted that my improved stops for the instrument consist of selectively actuable shafts 31, 32 and 33, there being one such shaft for each set of sixty-one key-controlled contactors 23, 24 and 25. Each of said shafts has a set of sixty-one cams 34, such that for each contactor 23, 24 or 25 of each set of sixty-one such contactors there will be a cam individual thereto and engaged therewith as shown. By this means, all contactors 23, 24 and 25 are open circuited relative to their coacting contactors 20, 21 and 22 when the playing key is fully raised. As long as said cams occupy the full line positions shown at Figure 5, contactors 20, 21 and 22 will be close circuited with contactors 23, 24 and 25 when the key is depressed, but should one or more of the shafts 31, 32 or 33 be turned so as to position its cams as illustrated by cam 34 at the bottom of Figure 5, then, in that event, the contactors 23, 24 or 25, as the case may be, will be lowered to positions to prevent engagement thereof with coacting contactors 20, 21 or 22. If all cams 34 upon shafts 31, 32 and 33 occupy the full line positions shown at Figure 5, contactors 20, 21 and 22 will be close circuited with their coacting contactors 23, 24 and 25 upon depression of the playing key, as shown. As a result thereof waveforms of potentials having the characteristics of oboe, violin and clarinet tones will be simultaneously impressed upon said common output circuit 27. Upon turning any selected shaft counter-clockwise, the contactors which are adapted to be controlled thereby will be depressed so as not to be close circuited with coacting contactors of the respective playing keys. This will be clearly understood upon referring to contactor 25 wherein cam shaft 33 has been turned to bring cam 34 to bear upon and to lower contactor 25 to the dotted line position. It follows that due to this condition, no waveform of potential corresponding to the timbre denoted by an associated stop will be impressed upon said output circuit upon depression of the playing keys. In like manner, any combination of timbres or any single timbre will be selectively effective upon the sound producing system 30 as and when desired by the player. Each of said shafts 31, 32 and 33 has a crank portion 35 provided with an actuating connection 36 adapted to be controlled from the keyboard of the instrument. When all stops of the instrument are drawn, no waveforms of potentials will be rendered effective upon said sound producer, whereby, and in the event that a piano is employed as disclosed in my aforementioned Patent No. 2,225,065, the keyboard can be used exclusively for the playing of piano music.

In the modified form of key switches shown at Figure 7, I show a set of key switches 50 for the bass or some other register of the instrument

and a similar set of key switches 55 for the treble register. The switches of the set of switches at the left of the figure are in positions so as to be close circuited when the playing keys associated therewith are depressed. The switches of the set of switches shown at the right of the figure have their contactors 56 lowered to positions where they will not be engaged with contactors 57 upon depression of their associated playing keys. As a result of this arrangement both sets of switches can be adjusted for close circuiting of all thereof according as different playing keys are depressed. However, when one set is adjusted to prevent close circuiting of the respective switches comprising said set, piano tones can be played exclusively when the respective playing keys common to said set are depressed.

Each generator of the system of generators herein disclosed will have recorded thereon sound produced by the sounding of an actual organ tone of the pitch and timbre of the tone desired to be associated with a respective playing key. The recording of sounds upon the generators will be effected at a slow recording speed. When the recording has been completed and the generators are incorporated in the organization as herein disclosed, they may be driven at any predetermined constant speed for the pitch at which it is desired the instrument shall be tuned.

In Figure 8 is shown a slightly modified form of stop mechanism for selectively preventing close circuiting of the key-operated electric switches of the instrument upon depressing the playing keys. I show but a single electric switch, the same comprising contactors 58 and 59. At 60 is a strip of thin electrically non-conductive material situated and mounted so as to be selectively projected between said contactors as shown in dotted lines to thereby electrically insulate said contactors from each other when the key is depressed. The strip 60 is normally retracted by a spring 61 and may be selectively advanced to said dotted line position by selective control of a manually actuated cam 62. In practice there generally will be one such strip 60 for each separate set of sixty-one key switches. When the low point 63 of the cam is as shown in full lines in Figure 8, the strip 60 is fully retracted. When the cam is turned to bring its high point 64 to bear against the strip, at which time, the cam will be on dead center, the strip will be held against returning to its retracted position.

Instead of employing tone wheel generators of the character herein shown and described, I may substitute therefor any well known type of oscillation generator without departing from the spirit of my invention. One such type is the vacuum or gas content tube, the output frequency of which is controlled in a manner well known in the art. The waveform of said output oscillations may also be predetermined in any well known manner. Two or more sets of said tubes can be employed and connected in my system substantially in the manner first above described. The waveforms produced by the tubes of one set of tubes will of course be different from the waveforms produced by the tubes of any other set or sets of said tubes, whereby different timbres will be available as desired. When either vacuum or gas content tubes are employed as frequency generators, use can be made of the systems set forth in U. S. patents, Nos. 2,250,066 and 1,832,402, respectively.

Similarly, I may employ any other well known

type of oscillation generator for producing complex tones in the pitch relation to notes associated with the different playing keys of the instrument.

I prefer to employ tone wheel generators of the type first above referred to in that tones simulating the various instruments can be more faithfully reproduced than has heretofore been possible with any of the various schemes of the prior art.

So far as I know, no one has ever before proposed employing in an electric organ, (1) two or more similar sets of continuously operating oscillation generators respectively producing tones of exactly the same pitch but differing in waveform, such that there is common to each individual playing key a plurality of tones of corresponding pitch, each representative of a predetermined timbre, (2) a system of stops directly coacting with the respective sets of generators through the key operated switches of the instrument, (3) a system of key switches of an exceedingly simplified construction, functioning in the system in the manner aforementioned, and (4) a system of generators, all of which have sound recordings of the actual tones of given instruments inscribed upon the generators at a common recording speed.

The above and other described features of my invention will therefore be claimed both broadly and specifically and with the reservation that I may change the specific details of construction of the parts without departing from the spirit of my invention.

Also, to the best of my knowledge, no one has ever before proposed driving all tone wheel generators of a system of such generators at a common operating speed, thereby eliminating entirely all of the heretofore existing complications and mechanical and functional inaccuracies resulting from the operation of generators, each of which must necessarily operate at a speed different from that of any other generator. Accordingly, this feature will be broadly claimed and while I suggest that motion shall be directly transferred to shaft 14 herein disclosed, motion may be indirectly transferred to said shaft in any suitable manner, such as by a speed reducing system, whereby the speed of the shaft will be such that the instrument can be tuned to the desired pitch. In the case herein illustrated, the motor 16 is designed to operate constantly at a rotational speed which has been predetermined so as to insure tuning the instrument to a predetermined pitch.

What I claim as my invention is:

1. In an electrical musical instrument employing a keyboard, the playing keys of which are each thereof provided with a set of electric switches, sources electrically connected with assigned switches of the sets of switches of different playing keys, said sources electrically generating for each individual playing key a series of waveforms of electrical oscillations of audible frequency corresponding to tones of different timbre and of pitches, all of which are the same as that of the note associated with said key, and a system of stops for controlling conduction to a load circuit of waveforms of oscillations from selected oscillation sources, said system of stops comprising a set of actuators for corresponding switches of the aforementioned sets of switches of the respective playing keys for open circuiting and thereby rendering said switches electrically inactive upon depression of said keys.

2. In an electrical musical instrument employing a keyboard, the playing keys of which are each thereof provided with a set of electric switches, a plurality of pulsation alternators simultaneously electrically generating for each individual playing key a plurality of waveforms of oscillations of audible frequency corresponding to tones of different timbre and of pitches, all of which are the same as that of the note associated with said key, circuit leads connecting switches of the set of switches of different playing keys with assigned ones of said alternators, and a system of stops for controlling conduction to a load circuit of waveforms of oscillations from selected oscillation sources, said system of stops comprising a set of actuators for corresponding switches of the aforementioned sets of switches of the respective playing keys for open circuiting and thereby rendering said switches electrically inactive upon depression of said keys.

3. In a musical instrument having a playing key, a plurality of circuit paths for the transmission of oscillations of audible frequency, each of said paths having an electric switch comprising contactors which are open circuited when the key is raised and adapted to be close circuited when the key is depressed, and a system of devices mechanically coacting with said contactors for preventing close circuiting of the contactors of any selected ones of said switches upon depression of said key.

4. In a musical instrument employing a keyboard, each individual playing key of which has a set of key-operated electric switches adapted to be close circuited in response to depression of said key, and a system of stops for and coacting with said switches for selectively preventing close circuiting of certain of said switches during close circuiting of others thereof when depressing selected ones of said playing keys.

5. In a musical instrument, a playing key having a set of electric switches adapted to be operated by said playing key, each individual switch of said set of switches comprising a contactor to which motion of the key is transferred and a contactor related to said first named contactor and adapted to be close circuited therewith upon depression of said playing key, and means selectively actuable for moving the second named contactor to a position sufficiently remote from said first named contactor to prevent close circuiting of the respective contactors upon depression of said playing key.

6. In a musical instrument, a playing key having a system of circuit controlling switches actuable by said playing key from open circuited conditions when the key is elevated to close circuited conditions when the key is depressed, and a system of devices in coaction with the switches of said system of switches for preventing close circuiting of any selected switch or and selected plurality of said switches upon depression of said playing key.

7. In a musical instrument, a set of stops, a plurality of playing keys, separate sets of generators of tone signal currents, each separate set of generators providing an individual generator for each playing key, the same generating a predetermined waveform of signal current of the frequency of the note associated with said key, means interconnecting each individual stop of said set of stops with generators of a respective set of generators for rendering effective upon a work circuit a waveform of signal current of the

timbre denoted by said stop, said interconnecting means including as many electric switches for and operated by each playing key as there are sets of aforementioned generators and said stops each including a member common to corresponding switches of as many playing keys for open circuiting said switches.

8. An electrical musical instrument comprising a plurality of sets of oscillation generators, the individual generators of said sets of oscillation generators each having sound recordings thereon of tones of predetermined pitch and timbre, means for driving the generators of all the aforementioned sets of generators at the same rotational speed, and a keying system for impressing oscillations of any selected pitch and waveform upon a work circuit.

9. In an electrical musical instrument, a generator of electrical oscillations, a playing key, an electric switch having a contactor operated by said key and connected to the output of said generator and a contactor adapted to be close circuited with the first named contactor upon depression of said playing key and adapted to be connected to a work circuit, and a member of electrically non-conductive material mounted for movement from a position wholly free of said first and second named contactors to a position of engagement of same with and to electrically insulate said contactors from each other.

10. In a musical instrument, a key controlled electric switch comprising coacting contactors which are open circuited when the key is raised and adapted for close circuited engagement with each other when the key is depressed, and means for selectively moving one of said contactors to a position of non-engagement thereof with the other contactor upon depression of said key.

11. In a musical instrument employing playing keys and a set of electric switches for and operated by each of said keys, means common to switches of each set of switches for simultaneously rendering same electrically inactive when operating said keys, and an oscillation generator for each individual switch of the set of switches of each key.

12. In a combined electric switch and stop mechanism for electric organs employing playing keys, a set of electric switches, there being one such set of switches for and actuable by each playing key, the individual switches of said set of switches being open circuited when the key is elevated and close circuited when said key is depressed; and means coactive with selected switches of the sets of switches of different playing keys for preventing close circuiting thereof upon depression of said keys.

13. In an electrical musical instrument employing playing-keys; an electric switch for and actuable by each individual playing-key, said switch being open circuited when the key is elevated and close circuited when the key is depressed; a set of switch controlling cams, such that there is one such cam for and disposed in actuating relation to each individual switch; and means for moving the cams from a position enabling the switches to be close circuited in response to depression of said playing-keys to a position to actuate the switches and prevent close circuiting thereof.

14. In an electrical musical instrument employing a keyboard and a set of electric switches for and actuable by each individual playing key of said keyboard, said switches being open cir-

cued when the playing keys are elevated and close circuited when said keys are depressed; a system of stops comprising actuators for corresponding switches of different sets of said switches, said actuators supported for motion from retired to drawn positions and adapted when retired to coact with corresponding switches of said playing keys to prevent close circuiting of said switches upon depression of said keys; and means for maintaining said actuators in either of the aforementioned positions.

15. In an electrical musical instrument employing a keyboard and a set of electric switches for and actuable by each individual playing key of said keyboard, said switches being open circuited when the playing keys are elevated and close circuited when said keys are depressed; a system of stops comprising a set of actuators for each individual set of the aforementioned switches, individual actuators of the respective sets of actuators being correlated to corresponding switches of the respective sets of switches, and means for simultaneously moving selected actuators into coaction with switches with which they are correlated to prevent close circuiting of said switches upon depression of said playing keys.

16. A combined electric switch and stop mechanism for electrical musical instruments employing playing keys comprising a set of electric switches for each individual playing key and including a plurality of contact devices actuated by said key and a plurality of contact devices for electrical coaction with said key actuated contact devices and open circuited relative thereto when the key is elevated and close circuited therewith when the key is depressed; and means for preventing close circuiting of selected key actuated contact devices with their electrically coactive contact devices upon depression of said playing keys.

17. In an electrical musical instrument employing playing keys; a set of electric switches for and actuable by each individual playing key and adapted to be close circuited in response to depression thereof and comprising a plurality of pairs of relatively movable contactors which are open circuited when the key is elevated and close circuited when the key is depressed; and means for selectively moving one contactor of each of predetermined pairs of contactors of switches of different playing keys beyond the range of close circuiting engagement with the other contactors of the same pairs of contactors and thereby pre-

vent close circuiting of the contactors of said predetermined pairs of contactors upon depression of said playing keys.

18. In an electrical musical instrument employing a playing key; a playing-key-actuated electric switch including a plurality of electrically coactive contactors which are open circuited when the key is elevated and close circuited when the key is depressed; and means for mechanically rendering said contactors electrically inactive upon depression of said key.

19. In an electrical musical instrument employing a playing key; a playing-key-actuated electric switch including a plurality of electrically coactive contactors which are open circuited when the key is elevated and close circuited when the key is depressed; and means for electrically insulating said contactors from each other to prevent close circuiting thereof upon depression of said key.

20. In a musical instrument employing a playing-key, a plurality of sources of tone frequencies, and a load circuit; an electric switch organization interposed between said frequency sources and said load circuit and comprising a plurality of pairs of electrically coactive contactors in which one contactor of each individual pair of contactors is electrically connected to an assigned one of said frequency sources and the other contactor of each pair of contactors is electrically connected to said load circuit, the first named contactors having mechanical connection with said playing-key so as to be actuable thereby to open circuit said contactors relative to the other contactors when the playing-key is raised, and means for preventing close circuiting of any selected one of the first named contactors with its electrically coactive one of the other contactors upon depression of said playing-key.

21. In an electrical musical instrument employing a playing-key, a plurality of sources of tone frequencies, and a load circuit; a playing-key-controlled electric switch organization interposed between said tone frequency sources and said load circuit, said switch organization comprising a plurality of contactors in which each individual contactor is electrically connected to an assigned one of said sources, and means coacting with said contactors for selectively determining which of said sources will be close circuited with said load circuit upon depression of said playing-key.

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