Nov. 18, 1952 P. H. ROWE 2,618,190

CHIME SYSTEM USING HARMONICALLY TUNED CHIMES

Filed Aug. 7, 1950 3 Sheets-Sheet 1

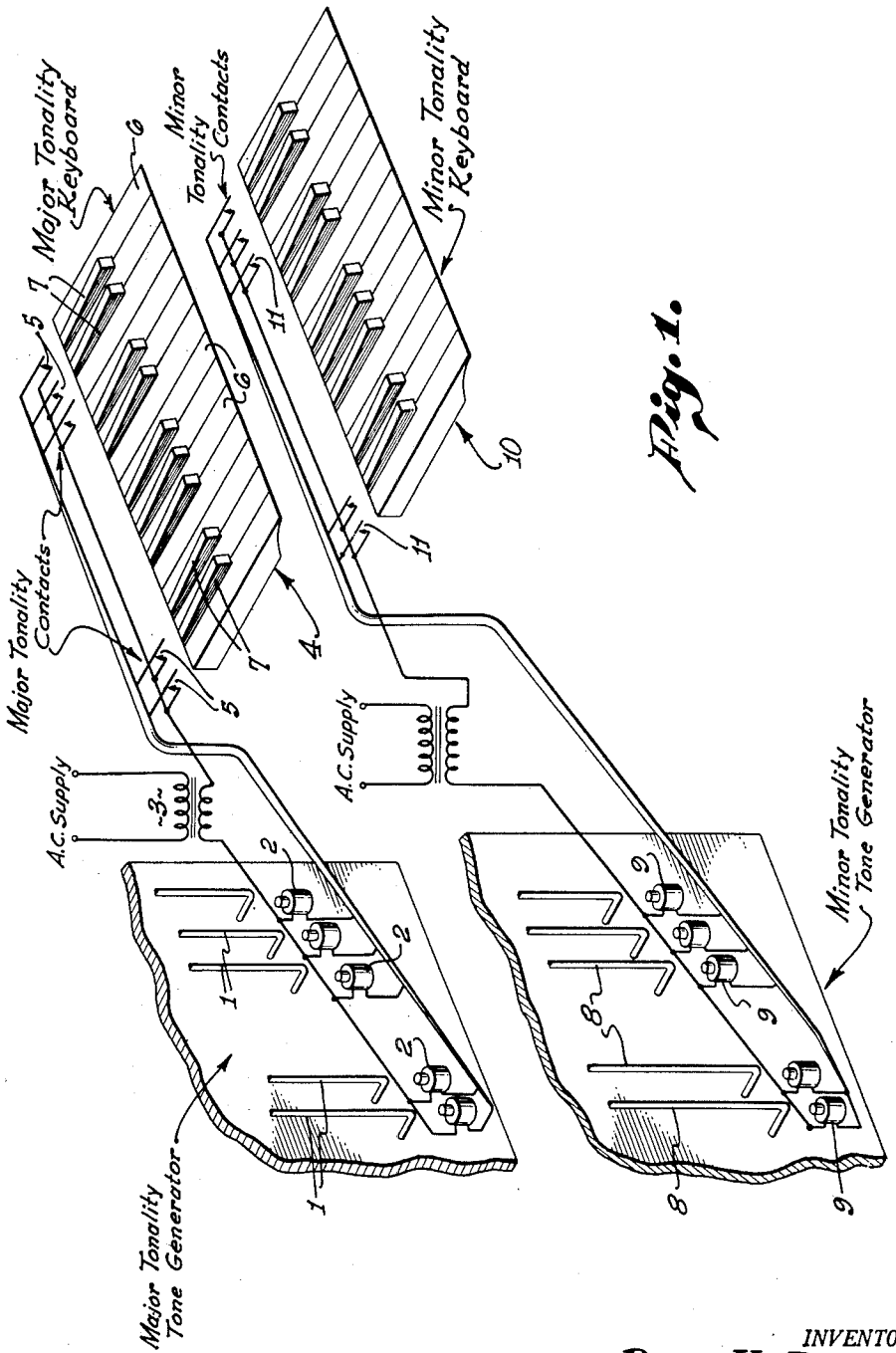


Fig. 1.

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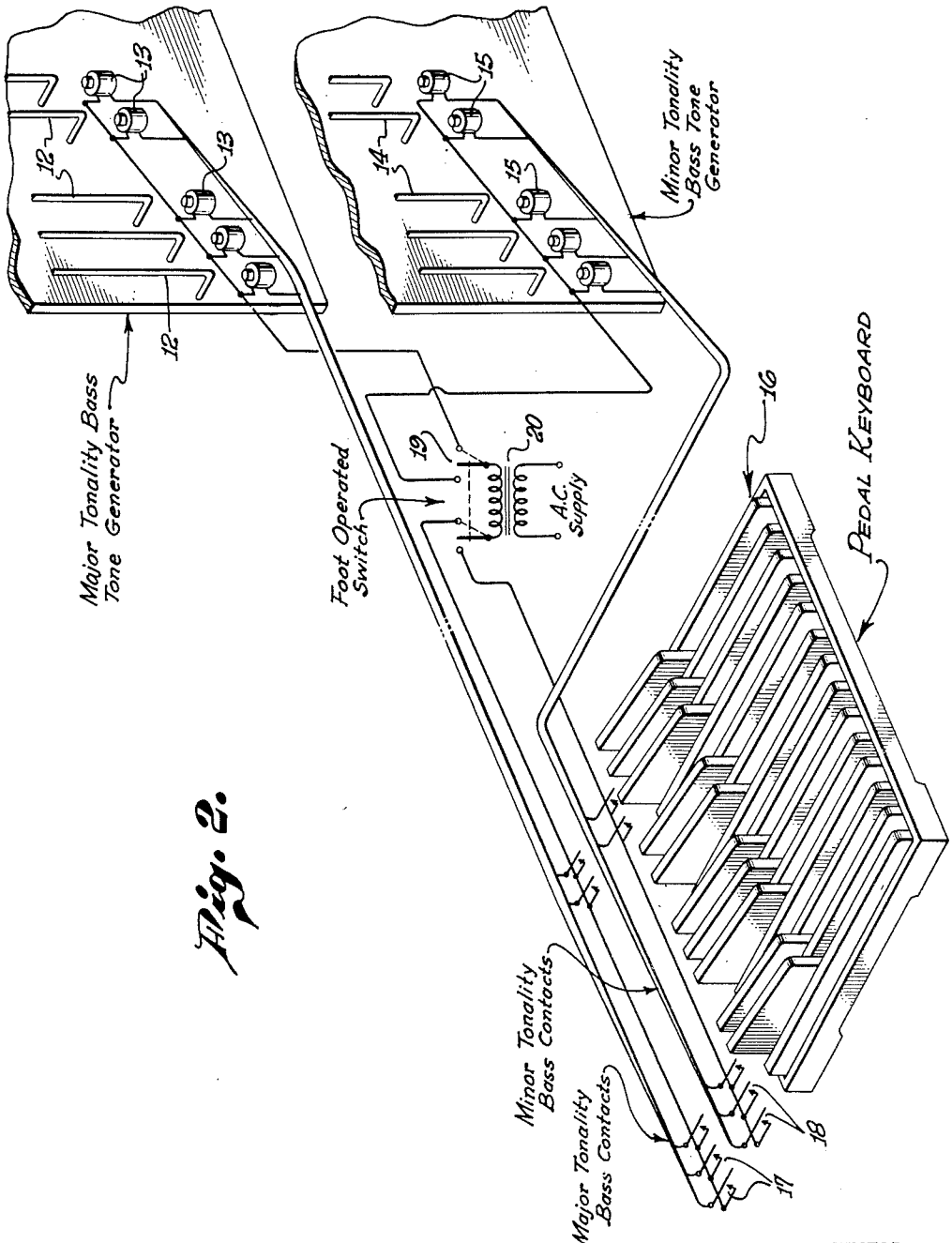


Fig. 2.

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Filed Aug. 7, 1950 3 Sheets-Sheet 3

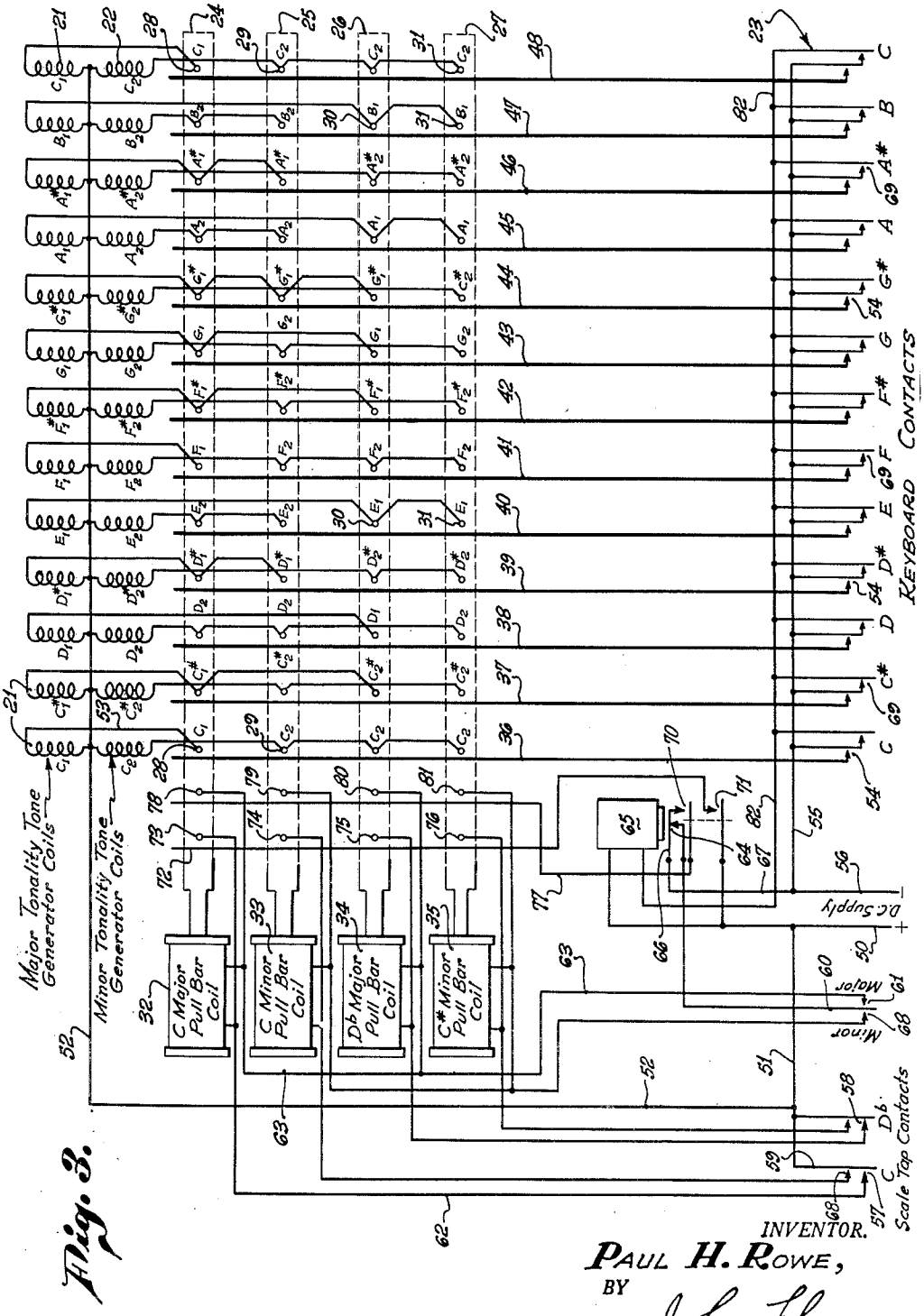


Fig. 3.

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Patented Nov. 18, 1952 2,618,190

UNITED STATES PATENT OFFICE

2,618,190

CHIME SYSTEM USING HARMONICALLY TUNED CHIMES

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Application August 7, 1950, Serial No. 178,110

8 Claims. (Cl. 84—405)

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This invention relates to an electrically operated chime system.

Chimes having bell-like tones, and operated electrically, are now well known and in common use. The chimes may be provided as a series of hollow resonant tubes, or as solid rods or bars. The tones resulting from striking such chime bars are quite similar to the tones produced by cast bells; and, often, for public performances in churches and auditoriums, such chime systems replace the bell systems.

It is well known that bells have individual and unpredictable vagaries and idiosyncrasies. Accordingly, when casting bells, it is difficult to produce bells that have pure pitch tones; and manual tuning of the bells is required, as by appropriate removal of material from the bell. Highly skilled and experienced technicians are necessary for this tuning process.

All bells inherently produce other tones besides the pitch tone, such as one or more subtones and one or more overtones. In most instances, such additional tones are inharmonious, and various ways of correcting them have been proposed. Aside from the octaves of the pitch tone, the most pronounced additional tone is usually one that approximates a third, corresponding to an interval of about three or four semitones, producing either a minor or a major third with respect to the pitch tone. In some bells, this tone is above the pitch tone; in others, it is lowered one octave, and considered a subtone. From a harmony standpoint, the octave position is immaterial.

It has been customary, when setting up the bells in a carillon, to use bells that all have, as this partial, either a major or a minor third.

It is one of the objects of this invention to provide a carillon of chimes so arranged that chords can be played by striking two or more chimes, without resultant discords, by the simultaneous production of the proper overtones or subtones.

In a Diatonic scale of one or more octaves, the interval from a given note to the third above may be either a major or a minor third, depending upon the identity of the first note. This is true because some of the notes of the scale are separated by two semitones, and others by one semitone. Taking, for example, an octave corresponding to the scale of C, adjacent notes are separated by either one or two semitones as indicated below:

C	D	E	F	G	A	B	C
2	2	1	2	2	2	1	

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A third interval between the following pairs of notes is a major third of four semitones:

C—E
F—A
G—B

Correspondingly, a third interval between the following pairs of notes is a minor third of three semitones:

D—F
E—G
A—C
B—D

Should all the chimes have an overtone or a subtone corresponding to a major third with respect to the pitch tone, then, if a third be sounded, for example, by sounding both note D and note F, the harmonic inherent in note D (a major third) would be one semitone out of tune with the sounded note F, and a discord would result. Similarly, sounding notes E and G simultaneously, or notes A and C simultaneously, would result in a similar semitone discrepancy.

Conversely, should all the chimes have an overtone or subtone corresponding to a minor third with respect to the pitch tone, then simultaneous sounding of notes C and E, or notes F and A, or notes G and B, would result in the production of harmonics that are a semitone out of scale harmony conformance with the higher note.

It is easy enough to provide chimes for any one scale, such as C, to overcome this difficulty. Thus, the chimes corresponding to notes C, F, and G may be tuned to produce a major third harmonic (or an octave below this major third, which is harmonically the same); and the chimes corresponding to notes D, E, A, and B may be tuned to produce a minor third harmonic (or an octave below this minor third).

However, such an arrangement would obviously be improper for any scale other than the scale of C major.

It is another object of this invention to make it possible to use any scale, and yet to ensure that the third intervals or chords played in that scale will have no inharmonious effect with the third partial of any chime.

It is another object of this invention to provide duplicate chime bars or rods, respectively having major and minor third partials (or octaves below such partials), the choice of sounding being optional by the player to conform to the scale or other harmony requirements.

This invention possesses many other advan-

tages, and has other objects which may be made more clearly apparent from a consideration of several embodiments of the invention. For this purpose, there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a diagrammatic view of one embodiment of the invention;

Fig. 2 is a diagrammatic view of another embodiment of the invention; and

Fig. 3 is a wiring diagram of a further modification.

In Fig. 1, a series of chime bars 1 are arranged in scale order. Only a few are shown for the series, for the sake of simplicity, but, of course, a full series is intended. The bars are of different lengths, so that the pitch tones correspond to a musical scale.

These chime bars may be tuned in accordance with the disclosure in prior applications filed in the name of Paul H. Rowe, Serial Number 69,658 filed January 7, 1949, now United States Letters Patent Number 2,588,295 issued March 4, 1952, and application Serial Number 115,350, filed September 13, 1949.

As set forth most clearly in the above-identified applications, it is possible to bring a subtone or overtone of the bar into substantially exact tonal concordance, as by determining the proportions of the bend ends and grooves to the overall length of the bar.

Each of the bars 1 in the series is fashioned in such manner as to produce, with respect to the pitch tone, a tone corresponding to a major third interval. In bars of this character, it is usual to provide the third interval by a tone one octave below the tone that would correspond to the third interval. Musically, however, the effect is the same.

Each of the bars 1 is provided with an electromagnetically operated striker 2 energized, for example, through a transformer 3, and individually controlled by the aid of the keyboard 4 operating the circuit controllers 5.

The keyboard, as shown, has thirteen white keys 6, and nine black keys 7, similar to a portion of a piano keyboard. Depression of any one of the keys 6 or 7 causes the appropriate contact 5 to be completed for sounding any one of the chime bars 1, or any combination of chime bars.

The number of chime bars 1, of course, corresponds in number to the white and black keys 6 and 7, and which are arranged, as heretofore stated, in a musical scale.

A second set of chime bars 8, tuned to the identical pitch tones as chime bars 1, is provided. However, in this instance, each of the bars 8 is tuned to provide a minor third tone, or an octave below such a minor third tone with respect to the pitch tone. The striker mechanisms 9 are similarly operated from a keyboard 10, the keys of which control the circuit controllers 11.

The series of chime bars 1 are played from the upper keyboard 4, and the series of chime bars 8 are played by the aid of the lower keyboard 10.

When it is desired to sound a chime bar, the player has a choice of sounding a chime bar in the series of bars 1, or one of the series of bars 8. If he strikes the appropriate key 6 on the upper keyboard, he produces a pitch tone including a major third. On the other hand, if the corresponding key is played on the keyboard 10, a corresponding bar 8 is struck, the pitch tone being the same as before, but with which there is a minor third partial.

As hereinabove explained, the choice of playing either the major tonality tone generator or the minor tonality tone generator depends upon the particular key in which the melody is played.

The musical score can appropriately indicate whether the keyboard 4, or the keyboard 10, is to be used for striking a note.

Thus, the notes may be designated by triangles; and, if the triangle points upwardly, the keyboard 4 is to be used for striking that note; or, if the triangle points downwardly, the keyboard 10 is to be used for striking the note.

The concurrent striking of more than one bar will not result in any discordant effects when attention is paid to the choice of the tone generators. Thus, in the key of C, the bars having the pitch tones C, F, and G will usually be struck in the series of bars 1, and all of the other notes on the white scale will be struck on the lower keyboard 10.

The form shown in Fig. 1 is adapted to be operated by the hands of a player. Often, in electrically operated musical instruments of this character, additional pedal keyboard is provided, the foot being used for depressing the keys corresponding to a bass register. Such an arrangement is shown in Fig. 2. The pedal keyboard has a range often overlapping the lower portion of the manual keyboard.

In this case, a set of chime bars 12 are provided with their strikers 13 for providing major third concordance in each of the bars. These chime bars are, of course, arranged in ascending scale order. The set of chime bars 14 produces, respectively, the same pitch tones as those in the series of chime bars 12; but in this instance, these chime bars 14 are arranged to produce a minor third concordance with respect to the pitch tone. Electrically operated strikers 15 are provided for the series of bars 14.

A common pedal keyboard 16 is provided for both sets 12 and 14.

Each of the pedals of the keyboard 16 is adapted to operate a series of circuit controllers, such as 17 and 18. However, only one circuit controller is effective to cause the striking of a bar corresponding to the pitch tone on the scale. By the aid of a foot-operated switch device 19, either one of the two sets of strikers 13 or 15 is energized by the transformer 20. This switch is operated by the foot of the player when he wishes to change from one set of chime bars to the other.

Thus, when the foot switch is arranged so that it assumes the dotted line position, the strikers 13 can be controlled by the pedal keyboard 16. On the other hand, when the foot switch 19 is in its other alternate position, then the strikers 15 may be energized by the aid of the pedal keyboard. This foot switch may be of the type in which successive operations by the foot cause alternate conditioning of the strikers 13 and 15.

Accordingly, when a melody is to be played, the musician has a choice of striking the appropriate chime bar either in the series of bars

12 or in the series of bars 14, and this choice is predetermined by the key in which the music is played.

In Fig. 3, a wiring diagram is indicated for conditioning the keyboard for playing music in any of a number of keys. Although only four keys (C major, C minor, D flat major, and C sharp minor) are provided for, obviously this system could be extended to cover the entire range of keys.

Furthermore, although bars sufficient to provide thirteen pitch tones are indicated, this number also may be readily extended.

There are two series of tone generator coils, designated by reference characters 21 and 22. The series of coils 21 are intended to cooperate with bars that produce major thirds, and the series of coils 22 are intended to cooperate with other bars that produce minor thirds, as hereinabove explained.

The circuits for each of the coils 21 and 22 are effected by a series of keyboard contact devices 23. When operating any of the keyboard contacts 23, a pitch tone is produced either by the aid of one of the coils 21, or by one of the coils 22. This choice determines whether the pitch tone will carry a major or a minor third tone, or an equivalent thereto.

The arrangement is such that the player can preset the mechanism correctly to condition either of the series of coils 21 and 22 that would correspond to the key in which the music is to be played.

Thus, there is a plurality of insulation bars 24, 25, 26, and 27. Bar 24 carries a series of spaced contact pins 28. Bar 25 carries a series of spaced contact pins 29. Bar 26 carries a series of spaced contact pins 30, and bar 27 carries a series of spaced contact pins 31.

Each of these bars is movable in a longitudinal direction, as by the aid of the solenoids 32, 33, 34, and 35, corresponding to the keys designated by legends appearing thereon.

Thus, when bar 24, for example, is moved to the left, all of the pins 28 respectively contact the buss bars 36 to 48, inclusive. Furthermore, the series of coils 21 and the series of coils 22 have connections to certain of the pins to control which of the coils in these two sets are connected to the pins of these bars. Thus, for the scale of C major, the solenoid 32 is energized, causing that coil of series 21 which corresponds to the note C to be connected to buss bar 36. That coil of series 22 which corresponds to the note D is connected to buss bar 38, and so on. In this way, the proper third tone is provided for the playing of music in the scale of C major; that is, the pitch tone bars C, D sharp, F, and G that are controlled by coils 21 are connected to the buss bars; and all the other pitch tone bars corresponding to the other notes of the key of C, and controlled by coils 22, are connected to other buss bars.

The black notes which do not belong to the key of C are also connected to one or the other tone generator in a predetermined manner. The choice for each black note depends on the most likely harmony requirements of such note when used as an accidental. The circuit shown adapts these notes to most of the accidentals used in popular hymns.

Correspondingly, if solenoid 33 is energized, the pins 29 connect certain of the coils 21 and 22 to correspond with the requirements of the key of C minor. Solenoids 34 and 35 are similarly arranged for the additional keys of D flat and C sharp minor.

When one of the solenoids 32 to 35 is energized, then, by depressing one of the keyboard contacts, the appropriate tone generator is caused to operate. Thus, when the key 23, corresponding to the tone C, is struck, the circuit for coil C_1 or C_2 is completed, depending upon which of the solenoids 32 to 35 is energized. If solenoid 32 is energized, for example, the circuit for coil C_1 in series 21 is energized in the following manner: from supply main 50, connection 51, common connection 52, coil C_1, connection 53, a pin 28, bar 36, contacts 54, and connection 55, to the other main 56. A similar circuit can be traced for each of the keys on the keyboard contacts 23.

A selection of one of the solenoids 32 to 35 is effected by scale tap contacts 57, 58, etc. Thus, when movable contact member 59 is depressed, and when contact arm 60 is moved to the right to contact the corresponding contact member 61, the solenoid 32 is energized through the following circuit: main 50, connection 51, arm 59, contact 57, connection 62, solenoid 32, connection 63, contact 61, arm 60, back contacts 64 of a holding relay 65 (the purpose of which will be hereinafter described), arm 66, and connection 67, to the main 56.

Similarly, the contacts 58 can be operated to energize the solenoid 34, corresponding to another major key.

By moving the arm 60 to the left to contact contact member 68, solenoid 33 is energized by the aid of the contact 69, corresponding to a minor scale.

At times, a musician may desire to change the key in which he is playing. This can be effected by depressing the appropriate key scale tap contact, corresponding to the new key, while the previous note is being played. Inorder to accomplish this, the holding relay 65 is utilized. This holding relay is energized whenever any of the keyboard contacts 23 is depressed. Thus, for example, assuming that the keyboard contact corresponding to the note D is depressed, the relay is energized through a circuit as follows: main 50, relay 65, connection 82, a contact 69, and connection 55, to the main 56. Contacts similar to contact 69 are arranged for each of the keyboard contact mechanisms 23. In this way, the holding relay 65 is energized whenever any one of the keyboard contacts is depressed.

Energization of the relay 65 causes the front contacts 70 and 71 to engage. However, the back contact 64 stays in engagement with arm 66 until after the front contact 70 is established. Accordingly, until the relay 65 is energized, that solenoid of the series 32 to 35 which is energized remains energized until the relay 65 completes its function.

The front contact 71 connects the main 50 to the buss bar 72, and is in the path of the pins 73, 74, 75, and 76 on the bars 24 to 27, inclusive. The front contact 70 connects the buss bar 77 to the other main 56, and is in the path of the pins 78, 79, 80, and 81, carried respectively on the bars 24 to 27.

Thus, when one of the keyboard contacts is depressed, and assuming that solenoid 32 is energized, this solenoid 32 continues to be energized through pins 73 and 78 and buss bars 72 and 77. Accordingly, it is possible to open the scale tap contact 57, corresponding to solenoid 32, and to close any other scale tap contact. When such a

scale tap contact is completed, then, upon release of the keyboard contact, that bar 24 to 27, inclusive, corresponding to the preselected scale tap contact, is pulled to condition the apparatus to playing the next note on another scale.

The above described keyboard condition switching system provides means for playing simple melodies on in-scale harmonics from a single keyboard, but it does not have the flexibility or harmonic possibilities which the hereinbefore described two keyboard arrangement provides. The two keyboard arrangement permits of harmonies in any key at will and permits the use of notes in which the partials are out of harmony with the scale when the musician feels these are desirable for special harmony effects. Its harmony capabilities are limited only by the ability of the performer.

The terms "corresponding to a major third interval" and "corresponding to a minor third interval," as used in the claims, refer not only to the third interval tones, but also to tones one octave below such tones, all as hereinabove described.

The inventor claims:

1. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; and means for optionally sounding any member in either series.

2. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for members; and circuit control means for optionally operating any of the strikers.

3. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a series of circuit controllers corresponding to the series of notes; and means for optionally connecting the strikers of each series to the circuit controllers.

4. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a plurality of circuit controllers respectively for selectively grouping the strikers to correspond to a definite scale; means for rendering any one of the circuit controllers effective; and means for energizing any one of the selected group of strikers.

5. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a plurality of circuit controllers respectively for selectively grouping the strikers to correspond to a definite scale; means for rendering any one of the circuit controllers effective; means for energizing any one of the selected group of strikers; and means responsive to the energization of any striker for maintaining the selected circuit controller active during energization of said striker.

6. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a plurality of circuit controllers respectively for selectively grouping the strikers to correspond to a definite scale; means for rendering any one of the circuit controllers effective; means for energizing any one of the selected group of strikers; and a relay energized in response to the energization of any striker for maintaining the selected circuit controller active independently of the said means.

7. In a chime musical instrument: a series of chime members arranged in scale order, each member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a plurality of circuit controllers respectively for selectively grouping the strikers to correspond to a definite scale; means for rendering any one of the circuit controllers effective; means for energizing any one of the selected group of strikers; and a relay energized in response to the energization of any striker for maintaining the selected circuit controller active independently of the said means; said relay having front contacts for energizing said selected circuit controller, as well as back contacts that serve to render said means ineffective.

8. In a chime musical instrument: a series of chime members arranged in scale order, each

member being structurally pretuned to include a pitch tone and another tone corresponding to a major third interval with respect to the pitch tone; a second series of chime members corresponding to the same scale order, each of said members in the second series being structurally pretuned to include a pitch tone and another tone corresponding to a minor third interval with respect to the pitch tone; electrically energized strikers respectively for the members; a plurality of circuit controllers respectively for selectively grouping the strikers to correspond to a definite scale; means for rendering any one of the circuit controllers effective; means for energizing any one of the selected group of strikers; and means

responsive to the energization of any striker for making it possible to preselect a circuit controller while the striker is energized.

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