July 31, 1962 J. A. KRAMER 3,046,826

SINGLE KEYBOARD ELECTRONIC CARILLON

Filed July 7, 1958 3 Sheets-Sheet 1

Fig. 1.

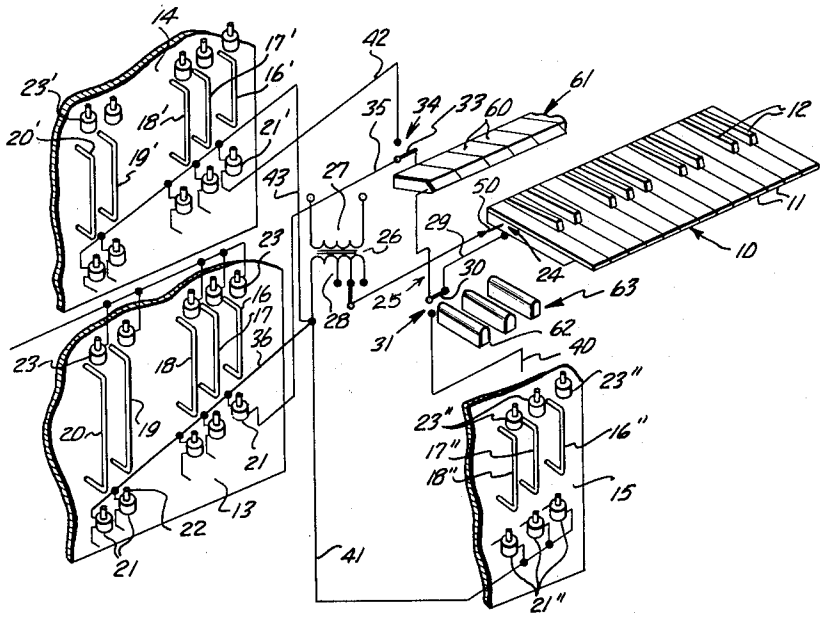
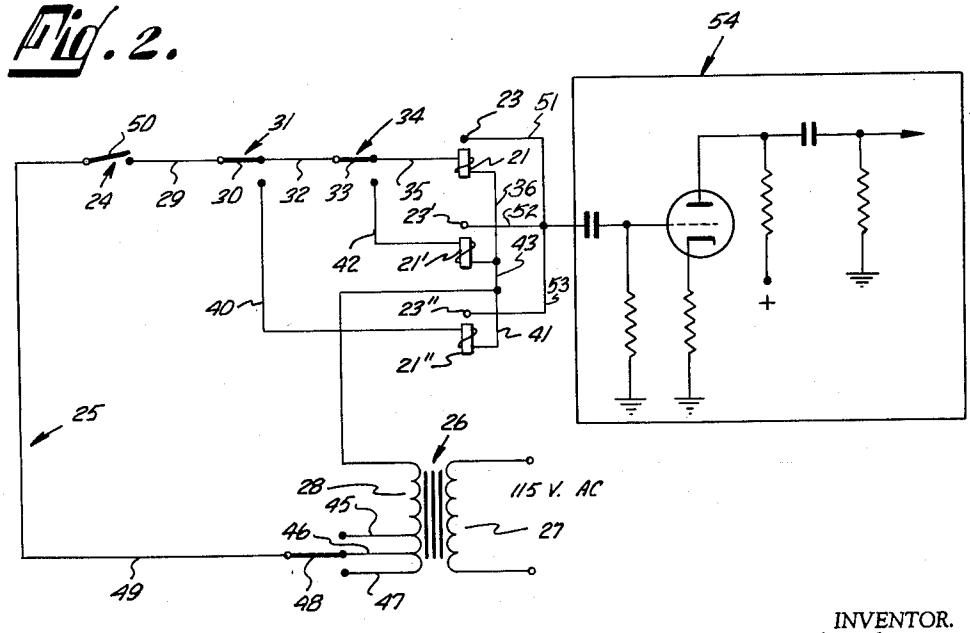


Fig. 2.



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SINGLE KEYBOARD ELECTRONIC CARILLON

Filed July 7, 1958 3 Sheets-Sheet 2

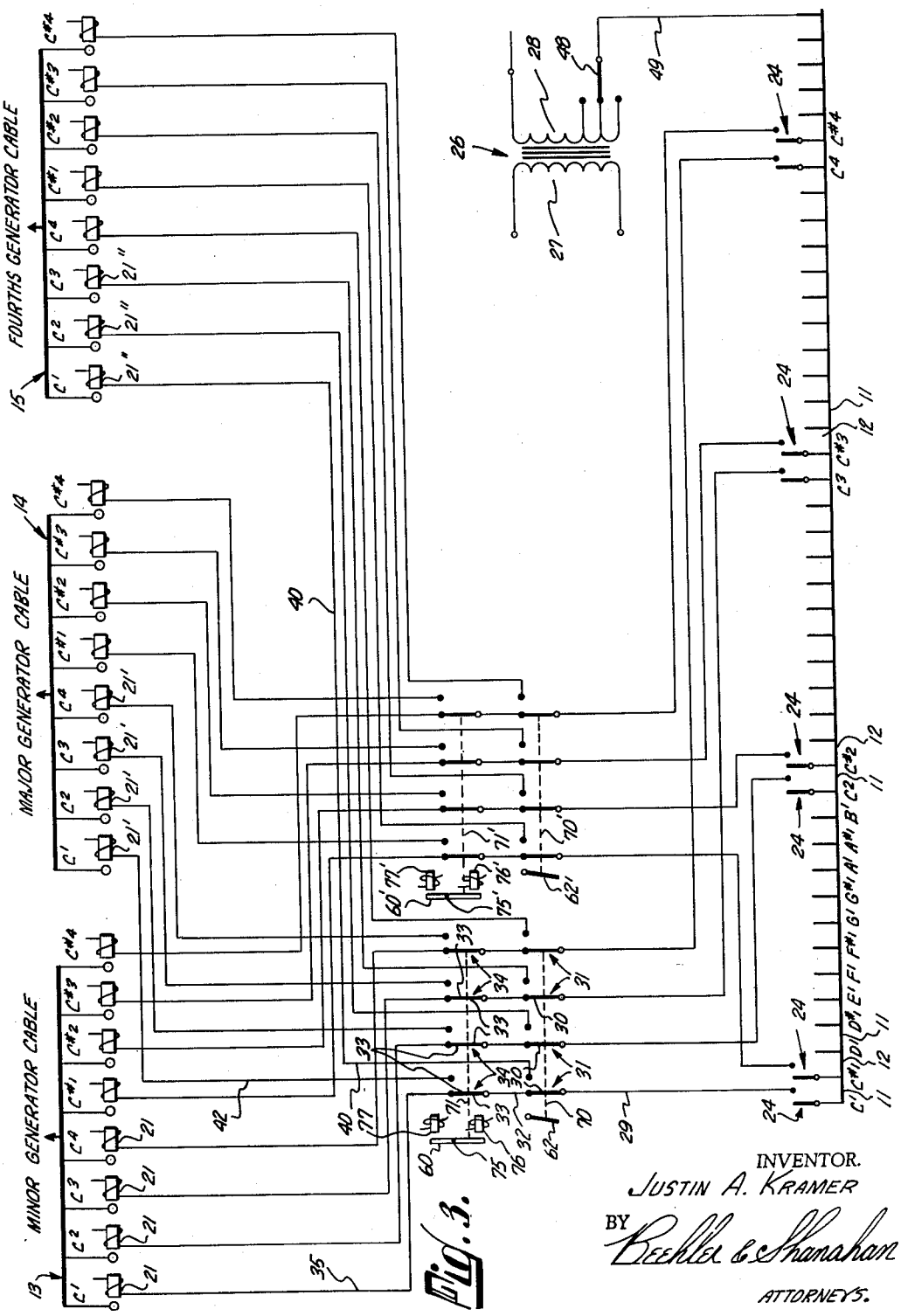


Fig. 3.

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Filed July 7, 1958 3 Sheets-Sheet 3

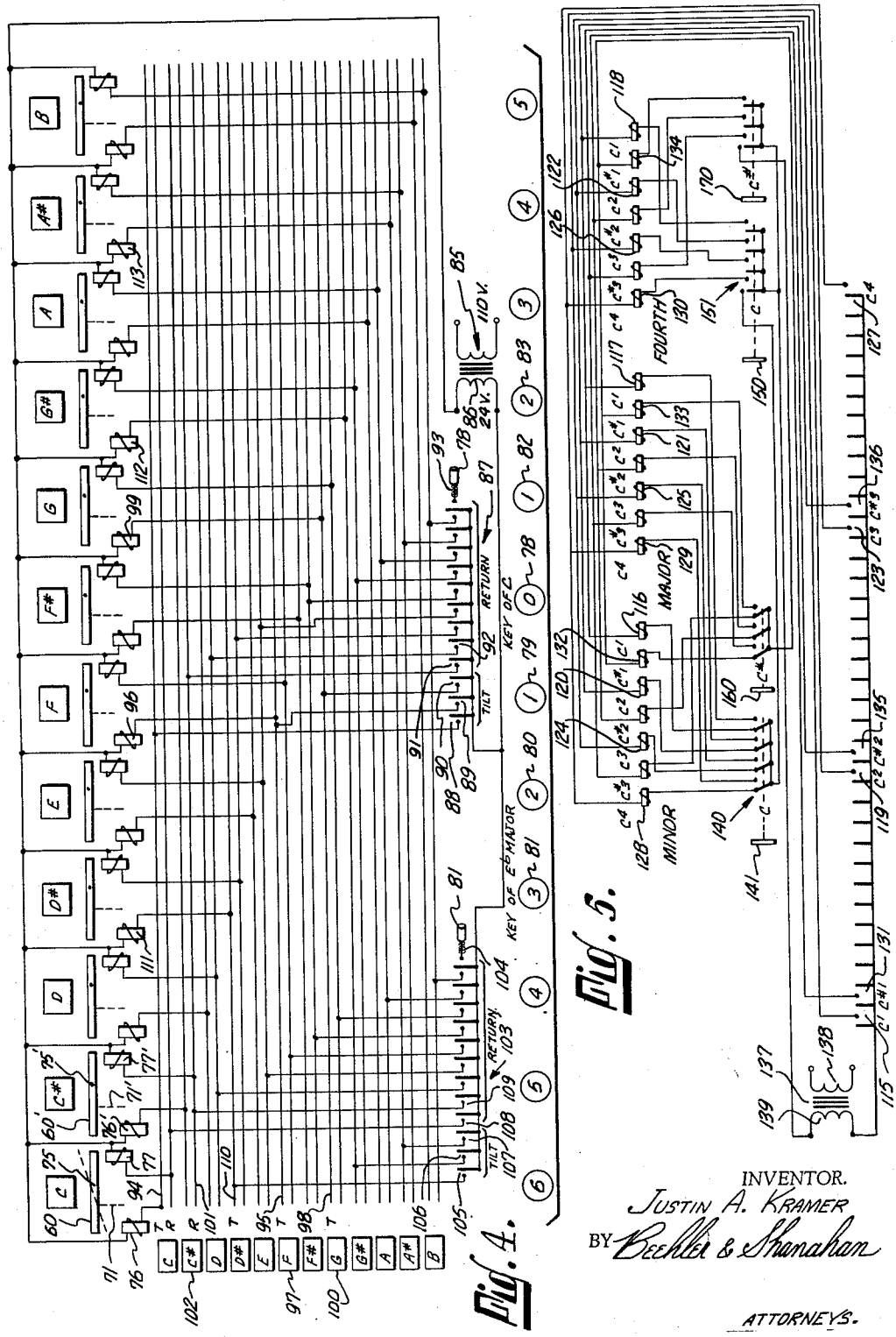


Fig. 4.

Fig. 5.

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3,046,826

SINGLE KEYBOARD ELECTRONIC CARILLON

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10 Claims. (Cl. 84—1.11)

The invention relates to carillons and has particular reference to those carillons which, regardless of the type of tone generator, are adapted to be actuated by electrically-operated strikers and arranged in such a fashion that one keyboard alone is adequate to properly and effectively play music which may, if desired, include chords and complex harmonies without the presence of discordant sounds which are characteristic of bell music.

It is quite commonly appreciated that chime type music generated by bells frequently sounds discordant or out of tune. This is true even though the bells are struck one note at a time. The discordant sounds are increased materially under those circumstances when more than one bell is struck simultaneously.

More recently, under circumstances where electrically amplified tuned bar tones have replaced the bells as tone generators, the discordant sounds have persisted. Some attempts to eliminate this condition have involved the construction of banks of tone generators in bar form as well as other forms where one bank containing all the notes of an octave has been tuned as Minor generators and a second bank has been tuned as Major generators. Although this scheme of minimizing discordant effects has been known and appreciated, employment of the scheme has necessitated a double keyboard, one for each bank of generators and a non-conventional musical score.

Although discordant effects are present to a degree when only a single octave of 12 notes is made use of in such a carillon and as the playing of a two keyboard instrument is not easy, on those occasions where two, three, and perhaps four octaves of generators have been employed using two separate banks of Major and Minor tuned generators, the problem of effectively playing music on an instrument of that kind with two separate keyboards has proved prohibitively difficult, even where only one note at a time is struck. Under circumstances where the musician is required to play chords, the degree of manipulation necessary to skip from one keyboard to the other at the proper interval and to accommodate music written in different keys reaches a point where only extremely skillful musicians, trained for many years especially in the handling of such instruments, are needed to produce music which can be tolerated. Even in the hands of such skilled musicians, music which is to be played must be specially written in unconventional form in order for it to be read.

It is, therefore, among the objects of the invention to provide a new and improved electrically-actuated carillon which is effective in eliminating discordant tones wherein the carillon employs but a single keyboard.

Another object of the invention is to provide a new and improved electrically-actuated carillon which is capable of being used to play the full range of chords in virtually any type of music without resulting in discordant and inharmonious sounds by use of only a single keyboard.

Still another object of the invention is to provide a new and improved electrically-actuated carillon-type of music instrument which is so constructed that the instrument can be pre-set to play in any key by use of a single keyboard without the necessity for any shifting while the key remains unchanged without producing the commonly experienced discordant effects which have characterized chime music in the past.

Still another object of the invention is to provide a new and improved electrically-actuated chime-type musical instrument wherein a multiple variety of banks of tuned tone generators can be employed, arranged in such fashion that the entire complement of generators can be pre-set to suit any key and any tone effect within the scope of the instrument, and the instrument then played on a single keyboard by use of conventional musical scores without the necessity of special markings and codings.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a schematic view of essential elements in the musical instrument wherein fragments only of separate banks of chime-like tone generators are shown interconnected with switches adjacent a single keyboard wherein multiple duplications of the generators and switching elements have been omitted in the interest of clarity.

FIGURE 2 is a wiring diagram of one circuit loop illustrating the manner in which the switching is accomplished from a generator for a single nominal pitch in one bank of generators to the generator for the same nominal pitch in each of two other banks of generators.

FIGURE 3 is a schematic drawing showing the wiring for two adjacent nominal pitches, or notes, of a keyboard in excess of three octaves of notes and illustrating the manner in which the instrument can be pre-set to shift automatically from one bank of generators to another while the musician manipulates the single keyboard.

FIGURE 4 is a schematic drawing showing an automatic system for setting the instrument so as to play in any selected key signature by manipulation of a single key signature button.

FIGURE 5 is a modified form of wiring system for manipulating the tone generator in three different banks of generators.

In an embodiment of the invention, chosen for the purpose of illustration, there is shown in FIGURE 1 a keyboard **10** of a substantially conventional type like the keyboard ordinarily used on a piano or organ. A portion only of the keyboard is shown in the interest of clarity, it being borne in mind that the disclosure herein presented comprehends a keyboard encompassing four octaves of standard piano-organ type keys, where white notes **11** and black notes **12** are made use of. Three banks of tone generators comprise the instrument, fragments only being shown and identified as a bank **13** of Minor tuned generators, a bank **14** of Major tuned generators, and a bank **15** of generators tuned in such a way as to entirely omit the tierce or replace it with a fourth.

In the chosen embodiment tone generators comprise bars **16, 17, 18, 19, 20**, etc., for example, in the bank **13** of Minor tuned generators. The bars will vary in length in order to give them the desired nominal pitch in the musical scale and may be tuned with respect to their partials by any acceptable tuning technique as, for example, by weakening portions of the bars, by bending ends of the bars at certain intervals, by weighting and such other means as are commonly practiced. Although bars are shown by way of example, the invention contemplates the striking of tone generators of any commonly used variety which may include conventional bells, chimes, hollow tubes, electronic generators, and the like.

In the example, solenoids **21**, which are electrically actuated, are employed to drive plungers **22** into contact with the bars. When the bars are struck they generate the required chime-like tone which is picked up by magnetic pick-ups **23**.

The bank **14** of Major tuned generators employs similar bars **16'**, **17'**, **18'**, **19'**, and **20'**, etc. The bank **15** of generators tuned without tierce employs likewise similar types of bars **16''**, **17''**, **18''**, etc. In each instance the solenoids **21** and plungers **22** are similar, as are also the magnetic pick-ups **23**.

For each of the black and white keys **11** and **12** there is a switch **24**, one only of which is shown. The switch is included in an electric circuit loop, indicated generally by the reference character **25**, which is energized by a transformer **26** having a primary **27** and a secondary **28**.

The electric circuit loop comprises a lead **29** connected to one pole of the switch **24** which, in turn, connects to an armature **30** of a two-pole switch **31**. An electric lead **32** from the closed pole of the two-pole switch **31** connects to an armature **33** of a second two-pole switch **34**. From the second two-pole switch **34** an electric lead **35** connects to the solenoid **21** for one of the tone generators of the generator bank **13**, which in the chosen example is the generator **16**. From the solenoid **21**, a common buss, or common electric lead **36**, connects to the secondary coil **28** of the transformer **26**.

From the two-pole switch **31**, a lead **40** connects to one of the solenoids **21''** of the bank **15** of tone generators. From the solenoid **21''**, a common buss, or lead **41**, connects back to the secondary coil **28** of the transformer **26**.

Similarly, from the other pole of the two-pole switch **34** an electric lead **42** connects to one of the solenoids **21'** of the bank **14** of tone generators. The solenoid **21'**, incidentally, is positioned to strike the tone generator **16'** which has the same nominal pitch as the generator **16** and also the same nominal pitch as the generator **16''**. A common buss **43** connects the solenoids **21'** and all of the solenoids **21'** back to the secondary coil **28** of the transformer **26**.

It will be noted that the secondary **28** of the transformer has three separate transformer leads **45**, **46**, and **47** from three different points on the secondary, and that a switch **48** is so positioned that it can interconnect with any one of the three leads. By this device a different amount of power from the transformer can be run through the electric loop and thus change the loudness with which the tone generators are struck. A lead **49** from the transformer secondary switch **48** interconnects with the switch **24** and its armature **50**.

To complete the electric circuit required to produce and reproduce the musical notes emitted by the generators, the magnetic pick-ups **23**, **23'**, and **23''** are connected respectively by leads **51**, **52**, and **53** to an amplifier circuit indicated generally by the reference character **54**.

It has already been indicated that the switch **24** for each of the loops is actuated by the respective key of the keyboard and that, inasmuch as the switch is normally open, actuation of the key will close the switch **24** and thus enable electric energy to flow through the loop with the two-pole switches **31** and **34** in the positions illustrated in FIGURES 1 and 2, particularly. When the electric loop is energized, the solenoid **21** only will be energized and this will actuate the corresponding tone generator or bar **16** in the bank **13** and thus produce a nominal pitch and partials of a Minor tuned generator in the particular chosen embodiment.

In order to shift to a Major tuned generator, such as the generator **16'** in the bank **14**, it is necessary to manipulate one of the tablets **60** of a set **61** of devices which may, for convenience, be designated "shift levers." By shifting the appropriate tablet, which in organ construction is commonly designated a "tilting" tablet, the armature **33** of the two-pole switch **34** is shifted so as to interconnect with the lead **42**. At the same time the circuit is broken to the lead **35** and when the tilting tablet has been set in this fashion, when the appropriate key of the keyboard is depressed, closing the switch **24**, the electric energy in the loop **25** will be diverted through the solenoid **21'** energizing that solenoid which will consequently cause the tone

generator **16'** to be struck. This tone generator is in the bank **14** of Major tuned generators and, hence, at that point a Major tuned bell sound will be produced instead of a Minor tuned bell sound.

On those occasions where it may be desired at a certain point to cause generation of a tone in the bank **15** of generators tuned without tierce, a pedal **62**, for example, in a second set **63** of shift levers is manipulated in order to change the setting of the two-pole switch **31** from the setting shown in FIGURE 2, for example, to a position where it interconnects with the lead **40**. With this adjustment, when the appropriate key of the keyboard **10** is depressed, closing the switch **24**, the electric energy of the loop **25** will be diverted through the lead **40** to the solenoid **21''** which, when actuated, will strike the tone generator **16''** and, thus cause a bell-like sound tuned without tierce partials to be sounded. It will be understood, of course, that when the solenoid **21''** is energized, the circuit will be broken to both the solenoid **21** and the solenoid **21'**, and hence only the tone generator **16''** will emit a musical sound.

It will further be understood that any one, or more than one, of the tilting tablets **60** may be depressed at any one time and that any one of the pedals **62** may be depressed at any given time. Thus, a desired setting is made possible whereby the musical tone which is generated may be shifted from one bank to another of the generators automatically when the corresponding key of the keyboard is depressed.

In order that the instrument be complete with respect to this described automatic operation of tilting tablets and pedals, the set **61** of tablets will contain 12 tablets, one for each semi-tone of the octave and, similarly, that in the set **63** of pedals there will be 12 pedals likewise corresponding to each semi-tone of the octave.

In the schematic portrayal of FIGURE 3, complete circuit loops are shown for each keyboard key of the nominal pitch C in each of four octaves, and a complete loop for each nominal pitch C♯ for each of four octaves. The complete loops for the remaining 12 keys, or nominal pitches, of the octaves have been omitted in the interest of clarity, but it is to be understood that they are wired in loops with corresponding switches, two-pole switches, and tone generators in the same fashion.

When one nominal pitch of an octave is to be shifted to either the bank **14** or the bank **15**, all of the nominal pitches, namely, the corresponding nominal pitches in each of the octaves, must also be so shifted. To accomplish this in an expedient mechanical fashion, the two-pole switches **31** and two-pole switches **34** may be grouped together in their respective groups. When mounted in this fashion, as indicated in FIGURE 3, an appropriate rod **70**, for example, connected to one of the pedals **62** is fastened to each of the armatures **30** of the corresponding two-pole switches so that when the pedal **62** is depressed the circuit will be broken simultaneously to all of the tone generators **16** in the Minor bank **13** and the circuit energized by the transformer will be closed through all of the leads **40** to the respective solenoids **21''** for each of the four octaves. Similarly, when the pedal **62** is returned to its normal position and the tilting tablet **60**, instead, is depressed, a rod **71** interconnecting all of armatures **33** of the switches **34** will cause all of the armatures to be simultaneously shifted so as to break the circuit through the solenoids **21** of the bank **13** of Minor tuned tone generators, and interconnect electrically the solenoids **21'** of the bank **14** of generators tuned to Major intervals for each of the nominal pitches in the four octaves.

A similar arrangement is shown for the nominal pitch shown as C♯ wherein a pedal **62'** is interconnected through a rod **70'** to all of the corresponding two-pole switch armatures and a tilting tablet **60'** is interconnected through a rod **71'** to all of the two-pole switch armatures for the corresponding nominals C♯. The switching to and from corresponding solenoids in the appropriate banks **13**, **14**.

and 15 of tone generators is accomplished in the same fashion as has already been described in connection with the nominals C.

From the foregoing description of the instrument and its operation, the manner in which the instrument will be played can be understood. The musician or performer will have before him the single keyboard, above which is a set of 12 tilting tablets, and which at some other convenient location, either at foot level or at one side or the other, may be a second set of 12 pedals. No matter what the key signature, the musician or performer will use the single keyboard and employ Major and Minor bells to their best harmonic advantage simply and without special music. The design does not concern itself with Major and Minor keys, as such, but is much more comprehensive in that it takes into consideration those musical selections which may be modal or based upon some other scale. Its simplicity in design relies upon the fact that modern music contains key signatures which, when altered, are clearly marked for the performer.

The single keyboard instrument is, therefore, particularly advantageous in the arrangement herein disclosed and described. On the 12 tilting tablets above the keyboard may be indications of the switching accomplished by them. They are appropriately labeled C, C♯ or D♭, D, D♯ or E♭, E, F♯ or G♭, G, G♯ or A♭, A, A♯ or B♭, and B or C♭. The convenience is further improved by coloring the tilting tablets black and white in a manner similar to the coloring of the black and white keys of the principal keyboard.

The same marking, or even variation in level, according to keyboard relationship may be employed for the pedals of the set 63 of pedals 62.

When all tablets are in off position, as previously indicated, only Minor bells are playable from the keyboard. When all tablets are in on position, only Major bells are playable from the keyboard. If only the C tablet is in on position, all the C's on the keyboard will control Major tuned bells, or generators, such as those in the bank 14, and all of the rest of the keys will control Minor controlled bells or generators.

When a musician or performer notes a key signature in sharps or flats, the appropriate tablets in the set of tilting tablets are depressed, thereby shifting those particular nominal pitches, or notes, into Major tuned bank of bells or generators. If, for example, the music has a key signature of 5 flats, the operator will press the buttons corresponding to 5 flats, namely, the tilting tablets D♭, G♭, A♭, and thus shift them to on position, which means the corresponding shifting of the appropriate two-pole switches.

If any accidentals occur in the composition, these should be determined in advance as to whether they are the root or third, or fifth of the underlying harmony and whether the underlying harmony is a Major, Minor, diminished, or augmented chord. The following tabulation is indicative of the technique:

(*a*) The root of a Major or Augmented chord will be played on a Major generator.

(*b*) The root of a Minor or Diminished chord will be played on a Minor generator.

(*c*) The third of a Major or Diminished chord will be played on a Minor generator.

(*d*) The third of a Minor or Augmented chord will be played on a Major generator.

(*e*) Where the accidental occurs as the fifth of a Major or Minor triad it should be played on the tone generator which has been tuned omitting the tierce. If the accidental occurs as the fifth of an augmented triad, it should be played on the Major tuned generator; and if the accidental occurs as the fifth of a diminished triad, it should be played on the Minor tuned generator.

In a carillon where there are both Major and Minor bells as well as bells where the Tierce has been omitted or removed to the fourth, wherever a Major or Minor triad is played, the fifth should be played on generators where the Tierce has either been omitted or removed to the fourth. These can be pre-selected by a foot switch or pedal which, as has been described, operates ahead of the tilting tablet. It should be noted that modulation to related keys is accomplished by changing but one or two tilting tablets.

It consequently will be understood that, even though two or even three entirely separate banks of tone generators be employed, be they rods, bells, tubes, electronic means, or other type devices designed to be struck to produce a musical tone, the switching arrangement herein shown and described is effective. The arrangement is such that all settings of consequence sufficient to shift from one bank to another are readily available, thereby making it possible to entirely avoid discordant sounds in advance for any key, and the entire piece of music can be played directly from the keyboard by reference to conventional musical scores.

In order to set the instrument quickly and easily, either before or during the playing of any composition, a system is provided as illustrated in FIGURE 4 such that the setting can be made by manipulation of a single button. This portion of the system is such that should the instrument be previously set in one key corresponding to some selected one of twelve key signatures, resetting the system to correspond to a new key signature cancels the previous setting at the same time that the new setting is made. The new setting, in fact, cancels any previous setting.

In the interest of clarity, the schematic drawing of FIGURE 4 is completed with respect to two keys corresponding to the key signatures of C Major and E♭ Major, by way of example, and it will be appreciated that the same system in all respects is employed for the remaining keys with an appropriate alteration in context as benefits the requisite notes for the different keys.

In order that the connection between the key setting system of FIGURE 4 be understood in its relationship to the basic manipulation of tone generators by the keyboard, reference is first made to FIGURE 3 and the tilting levers or tablets 60 and 60′ there shown. Adjacent the tablet 60 on one side of a pivot point 75 is a tube solenoid 76. On the opposite side of the pivot is a return solenoid 77. Similarly in connection with the tilting tablet 60′ there is a tilt solenoid 76′ on one side of a pivot point 75′, and a return solenoid 77′ on the opposite side. These solenoids are also shown in the upper left corner of FIGURE 4 where they carry correspondng numbers. Similar solenoids, not numbered, are also shown for the notes D, D♯, E, F, F♯, etc., across the top of FIGURE 4.

To make possible the setting of all of the requisite tablets for a selected key signature, a series of twelve buttons are shown. These are buttons 78, 79, 80, 81, etc., which are in the chosen illustration numbered from the center button 78 which is zero outwardly toward the left and toward the right. For convenience the zero numbered button carrying the reference character 78 is the button for music in the key of C Major or any music without a key signature. Button 79 may be for the key of F Major or any music having a key signature of B flat, button 80 for the key of B♭ Major or any music having the key signature of B flat and E flat, and button 81 for the key of E♭ Major or any music having the key signature of B flat, E flat, and A flat, and so on, through the flat keys up to and including the button at the extreme left. Similarly, button No. 1 to the right of button 78, identified by the reference character 82, is preferably for the key of G Major and those compositions which have a key signature of F sharp, button 83 for the keys having two sharps, F sharp and C sharp, and so on, through and including the button at the extreme right.

By way of example, the system is exemplified by switches and connections corresponding respectively to

button **78** for the key of C Major and all music with a key signature of no sharps or flats and also button **81** for the key of E♭ Major and all music with a key signature of three flats (B♭, E♭, and A♭). Conversely, in order to appreciate the simplicity of the shifting arrangement, it should be appreciated that for the key of E♭ Major and those keys having a key signature of three flats (B♭, E♭, and A♭), the shifts of the notes showing flats in the key signature may also be designated respectively as D♯, G♯, and A♯, inasmuch as these designations are those used in the schematic representation which is keyed to the tone generators heretofore described.

In the system of FIGURE 4 the circuit is energized by a transformer **85** which may be plugged into a power line carrying 110 volts in the primary and arranged so that a secondary **86** is rated, for example, at 24 volts.

For the button **78** representing the key of C Major and tonalities having no sharps or flats in the key signature, there is a gang switch indicated generally by the reference character **87** which consists of twelve individual switches or switch points. Those at the left end of the gang switch have been identified by the reference characters **88**, **89**, **90**, **91**, and **92** by way of example. The gang switch may be one of conventional design wherein by depression of the button **78** every switch in the gang is temporarily moved to contact position, whereafter by action of a return spring **93**, the button and the switches are moved back to an original position of disengagement.

When the gang switch is shifted to circuit closing position, switch points **88**, **89**, and **90** are so connected in the circuit that they operate tilt solenoids for the respective nominal pitches or fundamentals designated by the letters C, F, and G in their respective octaves. The remaining nine switch points are so arranged that they close circuits to nine solenoids, all of which are return solenoids. Therefore, regardless of which button may have been depressed previously, that setting will be cancelled by depression of the button **78** and the generator is all set for the key of C Major and all music having no sharps or flats in the key signature.

To further appreciate the operation in connection with the description of parts, attention is directed to the switch point **88** which, when closed so as to energize that circuit, interconnects with a wire **94** leading to tilt solenoids **76** for the nominal pitch C or octaves of C. By reference to FIGURE 3, it will be noted that the four octaves of the note C by manipulation of the switches **34** are shifted so that the bank **14** of Major tuned tone generators are connected.

Similarly, when the switch point **89** is connected in circuit, a wire **95** is interconnected in the circuit which is connected to a tilt solenoid **96** of the octaves of F through a master buss bar of the group designated **97**. Contact points **90** when closed interconnect with a wire **98** which energizes a tilt solenoid **99** of the octaves of G through a master buss bar of the group designated **100**. In the last two instances it will be appreciated that appropriate switches interconnected with the tone generators will accordingly shift all octaves of F and G to the Major tone generator bank. Conversely, by way of example, closing of the switch point **91** passes current through a wire **101** which energizes the return solenoid **77′** through a master buss bar of the group **102** for the octaves of C♯. All of the remaining switch points similar to the switch points **91** and **92** will energize return solenoids.

After the setting just described, should the key signature of the musical score indicate three flats or the key of E♭ Major and those tonalities with a key signature of B♭, E♭, and A♭, as it is usually identified, the button **81** is momentarily depressed. This momentarily shifts a gang switch, indicated generally by the reference character **103**, closing all of the switch points, after which the button and gang switch is returned by a spring **104**. The temporary engagement, however, causes a switch point **105** to energize a wire **110** which controls a tilt solenoid **111** for the nominal pitch D♯ to be actuated. Switch point **106** similarly actuates a tilt solenoid **112** for the nominal pitch G♯ and switch point **107** actuates a tilt solenoid **113** for the nominal pitch A♯. Conversely, switch point **108** actuates return solenoid **77** for the nominal pitch C and hence cancels the tilt setting which was previously accomplished by the manipulation of the button **78**. Switch point **109** when closed energizes return solenoid **77′** for the nominal pitch C♯. If the tilt solenoid for the nominal pitch C♯ has been previously set for the Major generator bank, the new setting will assure that the nominal pitch C♯ is played on the Minor generator bank.

From the foregoing description it will be appreciated that in the same fashion each of the buttons when it is depressed can be made to actuate a similar gang switch, the individual switch points of which are appropriately connected to the desired respective tilt and return solenoids, thereby to set three of the solenoids to shift from corresponding Minor tone generators to Major tone generators and to return all of the remaining switch settings to the fundamental Minor tone generator bank. The normal arrangement of the twelve nominal pitches is such that three tilt settings are sufficient to accommodate all flat keys and all sharp keys as well as the key of C. Moreover, the buttons are such that they need not be employed unless desired inasmuch as the tilting tablets can be tilted manually and individually so long as manipulation of the button is left undisturbed. Hence, in the arrangement shown where the bank of tone generators tuned without tierce are to be introduced at any time, they can continue to be introduced by manipulation of the pedals previously described without disturbance of any portion of the system other than as desired.

In the form of invention illustrated in FIGURE 5, the wiring for actuation of the tone generators by manipulation of the keyboard differs somewhat from the wiring disclosed in connection with FIGURE 3 without, however, departing to a major degree from the basic concept.

As there shown the key **115** which corresponds to the lowermost octave C is connected directly to the solenoid **116** in the Minor bank, the solenoid **117** in the Major bank, and the solenoid **118** of the bank tuned without tierce. Similarly, the key **119** is directly connected to solenoids **120**, **121** and **122** actuating respectively Minor and Major tone generators and generators tuned without tierce which in some instances in the interest of brevity have been referred to as Fourths. Key **123** of the keyboard in turn is connected to solenoids **124**, **125** and **126**, whereas key **127** is connected to solenoids **128**, **129** and **130**. Correspondingly the lowermost key **131** for C♯ is connected to solenoids **132**, **133** and **134** respectively in the Minor bank, Major bank and fourth bank. The remaining keys for C♯ **135** and **136** are similarly directly interconnected. In this system a transformer **137** having a 110 volt primary **138** actuates a secondary **139** which supplies power to the system through the wiring as shown.

As indicated, normally a set **140** of tilting tablets is in a position such that a tilting tablet or lever **141** is in a position such that individual switches are closed to circuits interconnecting the solenoids **116**, **120**, **124** and **128**. Consequently when any one of the keys **115**, **119**, **123** or **127** is struck, a corresponding tone generator in the Minor bank will be actuated. To shift to the Major bank, the tilting tablet or lever **141** is tilted in order to throw the switch connections to a position wherein the solenoids **117**, **121**, **125** and **129** are energized and the previously identified solenoids **116**, etc., are de-energized. With this setting when any one of the corresponding keys of the keyboard are manipulated, the solenoid of the Major tuned bank is actuated.

Regardless of the position of the tilting tablet **141**, if the generators of the bank tuned without tierce are to be

made use of, a tilting tablet or member, here shown as a pedal **150**, is manipulated which actuates a set **151** of switches in a direction such that solenoids **118, 122, 126,** and **130** are energized. Consequently, in this setting when one of the keys **115**, etc., is manipulated, the solenoids in the bank of generators tuned without tierce will be called upon. When the last identified pedal **150** is manipulated, the circuit will be broken to the set of tilting tablets **140** controlled by the tilting tablet or lever **141.**

The solenoids operated by the keys **131, 135, 136** are subject to a tilting tablet **160** which when operated serve to change the setting of the C♯ keys from the Minor bank to the Major bank in the same manner as has previously been described in connection with the C key. Similarly a pedal **170** is connected in the circuit in a fashion similar to the pedal **150** and serves to shift the C♯ keys to manipulation of solenoids in the bank of generators tuned without tierce.

It will be appreciated from the foregoing explanation in company with the wiring diagram of FIGURE 5 that the connections in this form of the invention are simple and direct and that they are further such that they can be used with the portion of the circuit described in detail in connection with FIGURE 4.

There has accordingly been shown and described herein a carillon which by making use of circuits and solenoids in company with banks of tone generators tuned differently makes a system which is extremely simple from the point of view of the musician. This lies largely in use of but a single keyboard with a limited number of arbitrary adjustments such that the musician while sitting at the keyboard can by pushing a button or tilting a lever or pedal shift the operation from one bank of generators to another and thereby create the most desirable tone characters in the instrument without it being necessary to do other than play upon the keyboard from one single musical score.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a musical instrument employing tone generators and an electrically actuated striker for each tone generator, the combination of a single keyboard encompassing at least one octave of keys and a separate key on the keyboard corresponding to each nominal pitch in the octave, alternate banks of generators with nominal pitches in musical scale order, said generators in the alternate banks being of substantially the same timbre and quality, one of said banks of generators having nominal pitches tuned to Minor partials and another of said banks having nominal pitches tuned to Major partials, a plurality of electrically energized circuit loops comprising a loop for each key, each said loop comprising a normally open switch in operative engagement with the respective key, a striker and generator combination of one of said banks, a two-pole switch in each loop having an armature in one position against one of said poles normally closing a connection to said last identified striker only, a striker and generator combination of the other of said banks having the same nominal pitch as the first striker and generator combination and a connection from the other pole of said two-pole switch to said last identified striker only; a set of shift levers comprising a lever corresponding to each nominal pitch in the octave, one lever being operably connected to the armature of each of the two pole switches and operable upon actuation to shift the armature to the other of said poles whereby to set the circuit in open condition to the respective generator in one of said banks and set the circuit in closed condition to the respective generator in the other of said banks.

2. In a musical instrument, tone generators and an electrically actuated striker for each tone generator, a single keyboard encompassing a plurality of octaves of keys and a separate key on the keyboard corresponding to each nominal pitch in each octave, alternate banks of said generators with nominal pitches in musical scale order, the generators in one bank having the same timbre and quality and having respectively the same nominal pitches as the generators in the other banks, one of said banks having nominal pitches of the generators therein tuned to minor partials and the other of said banks having nominal pitches of the generators therein tuned to major partials, an electric circuit interconnecting said strikers, an electrically energized circuit loop for each key having a series of elements therein comprising a normally open switch in operative engagement with each key on the keyboard, a striker and generator combination of one of said banks of generators, a two-pole switch having an armature in one position against one of said poles normally closing a connection to said last identified striker only, a striker and generator combination of the other bank having the same nominal pitch as the first striker and generator combination and a connection from the other pole of said two-pole switch to said last identified striker only; a set of shift levers operatively associated with said loops comprising a plurality of levers, each nominal pitch in the octave having one of said levers corresponding thereto, each one of said levers being operably connected only to the armature of the two-pole switch of the same nominal pitch of all the octaves and operable upon actuation to shift the armatures to the other of said poles to a position wherein the circuit is open to the respective generators of the same nominal pitch in the corresponding bank and the circuit is closed to the respective generators of the same nominal pitch in the remaining bank.

3. In a musical instrument, tone generators and an electrically actuated striker for each tone generator, a single keyboard encompassing a plurality of octaves of keys and a key on the keyboard corresponding to each nominal pitch in each octave, a first bank of said generators having nominal pitches in musical scale order tuned to minor partials, a second bank of said generators having substantially the same timbre and quality and having corresponding nominal pitches in musical scale order tuned to major partials, an electric circuit interconnecting said strikers, an electrically energized circuit loop for each said key having a series of elements therein comprising a normally open switch in operative engagement with the respective key, a striker and generator combination of said first bank, a two-pole switch having an armature in one position against one of said poles normally closing a connection to said last identified striker, a striker and generator combination of said second bank having the same nominal pitch as the first striker and generator combination and a connection from the other pole of said two-pole switch to said last identified striker only; a set of shift levers operatively associated with said loops comprising one lever corresponding only to each nominal pitch in the octave, one lever of said set being operably connected to the armature of the two-pole switch of the same nominal pitch of all of the octaves and operable upon actuation to shift the armatures to a temporary fixed position at the other of said poles whereby to open the circuits to the respective generators of said first bank and close the circuits to the respective generators of said second bank.

4. In a musical instrument, chime tone generators and an electrically actuated striker for each tone generator, a single keyboard encompassing at least one octave of keys and a key on the keyboard corresponding to each pitch tone in the octave, alternate banks of generators with root tones in musical scale order, a bank of said generators having the pitch tones of said generators tuned to minor partials and another of said banks having genera-

tors therein of the same timbre and quality as the generators of the first bank, said generators having pitch tones tuned to major partials, an electric circuit interconnecting said strikers including a transformer having the secondary element in said circuit, a plurality of leads for different numbers of windings on said secondary element and switch means alternatively connecting said leads whereby to vary the volume effect of said generators, an electrically energized circuit loop in said circuit for each key comprising a normally open switch in operating engagement with the respective key, a striker and generator combination of one of said banks, a two-pole switch having an armature in one position against one of said poles normally closing a connection to said last identified striker only, a striker and generator combination of the other of said banks having the same nominal pitch as the first striker and generator combination and a connection from the other pole of said two-pole switch to said last identified striker only, a set of shift levers comprising a lever corresponding to each nominal pitch in the octave, each of said levers being operably connected only to the armature of the respective two-pole switch and operable upon actuation to shift the armature to the other of said poles whereby to temporarily set the circuit in open condition to the respective generator in one of said banks and set the circuit in closed condition to the respective generator in the other of said banks.

5. In a musical instrument chime tone generators and an electrically actuated striker for each tone generator, a single keyboard encompassing at least one octave of keys and a key on the keyboard for each nominal pitch in the octave, alternative first, second and third banks of generators in musical scale order, nominal pitches of generators in the respective banks being of the same timbre and tuned respectively to minor, major and fourth partials, an electrically energized circuit loop for each key having a series of elements therein comprising a normally open switch in operative engagement with the respective key, a striker and generator combination in the first bank, a two-pole switch having an armature in one position against one of said poles normally closing a connection to said last identified striker only, a striker and generator combination in the second bank having the same nominal pitch as the first striker and generator combination and a connection from the other pole of said two-pole switch to said last identified striker; a set of shift levers operatively associated with said loops comprising a plurality of levers, each nominal pitch in the octave having one of the levers corresponding thereto, each of said levers being operably connected only to the armature of a different two-pole switch and operable upon actuation to reset the armature in a temporary fixed position at the other of said poles whereby to open the circuit to the respective generator in one of said banks and close the circuit to the respective generator in the other of said banks, each said loop comprising a second two-pole switch having an armature in one position against one of said poles normally closing a connection to the first identified striker of the respective loop, an electric connection from the other pole of said second two-pole switch to a striker and generator combination and of the same nominal pitch as said first identified striker and generator combination and in said third bank of generators; a second set of shift levers operatively associated with said loops, each lever of said second set corresponding to a different nominal pitch in the octave, each lever of the second set being connected to the armature of the respective second two-pole switch and when the respective first two-pole switch is in normal position being operable in each instance upon actuation to shift the armature of the second two-pole switch to the other pole of the second two-pole switch whereby to open the circuits to the first bank of generators and close the circuits to the respective generators of the third bank of generators.

6. In a musical instrument, tone generators and an electrically actuated striker for each tone generator, a keyboard encompassing at least one octave of keys and a key on the keyboard corresponding to each nominal pitch in the octave, alternate banks of generators with nominal pitches in musical scale order wherein one bank is tuned to one category of partials and another is tuned to another category of partials, an electrically energized circuit loop corresponding to each key having a series of elements therein comprising a first switch in operative engagement with the respective key adapted to open and close said circuit loop, a striker and generator combination of one of said banks operably connected to said circuit loop, a second switch having connections in said circuit loop and an armature operably associated with said connections having one position of engagement relative to said connections enabling operation of said last identified striker, a striker and generator combination of the other of said banks operably connected to said circuit loop and having the same nominal pitch as the first striker and generator combination, said armature of the second switch having another position of engagement relative to said connections enabling operation of said striker of the other of said banks, portions of said instrument outside said circuit loop comprising a set of shift elements, shift elements of said set corresponding respectively to each nominal pitch in the octave, said shift elements being operably connected respectively to the armature of the respective second switch, a pair of oppositely acting solenoids in said circuit loop for each shift element, said solenoids being operable alternatively in response to actuation by said second switch to move said shift element respectively to setting and return positions, a signature key-setting gang switch for each of a plurality of musical key signatures each having a plurality of individual switch points connected respectively to corresponding solenoids of said shift elements, said gang switches being electrically independent one from another, one group of said individual switch points being connected to setting position solenoids and the remaining individual switch points being connected to return position solenoids, and one button only for each gang switch, said gang switch being operably connected to the respective button whereby to set the levers corresponding to a selected musical key signature and return all others.

7. In a musical instrument employing tone generators and an electrically actuated striker for each tone generator, the combination of a keyboard encompassing a plurality of octaves of keys and a key on the keyboard for each nominal pitch in the octave, alternate banks of generators with nominal pitches in musical scale order wherein one bank is tuned to one category of partials and another is tuned to another category of partials, an electrically energized circuit loop corresponding to each key having a series of elements therein comprising a first switch in operative engagement with the respective key, a striker and generator combination of one of said banks operably connected to the circuit loop, a second switch having connections in said circuit loop and an armature operably associated with said connections having one position relative to the connections enabling operation of said last identified striker, a striker and generator combination of the other of said banks operably connected to said circuit loop and having the same nominal pitch as the first striker and generator combination, said armature of the second switch having another position relative to said connections enabling operation of said last identified striker, portions of the instrument outside said circuit loop comprising a set of shift levers, levers of said set corresponding respectively one to each nominal pitch in the octave, said levers being operably connected one to the armature of the respective second switch, a pair of oppositely acting solenoids in said circuit loop for each lever, said solenoids being operable alternatively in response to actuation by said armature to respectively set and return said lever, a key-setting gang switch for each of a plurality of musical key signatures, each having a plurality of individual switch points connected respectively to corresponding solenoids of said levers, one group of said individual switch points being connected to setting solenoids and the remaining individual switch points being

connected to return solenoids, said gang switches being electrically independent of each other, and a single button operably connected to each gang switch, said gang switch being subject to operation by the respective button to set the levers corresponding to a selected musical key signature and return all others.

8. In a musical instrument employing tone generators and an electrically actuated striker for each tone generator, the combination of a single keyboard encompassing a plurality of octaves of keys and a keyboard key corresponding to each nominal pitch in each octave, alternate banks of generators with nominal pitches in musical scale order wherein one bank is tuned to minor partials and another is tuned to major partials, an electrically energized circuit loop corresponding to each keyboard key having a series of elements comprising a normally open switch in operative engagement with the respective key, a striker and tone generator combination of one of said banks, a two-pole switch having an armature in one position against one of said poles normally closing a connection to said last identified striker, a striker and tone generator combination of the other of said banks having the same nominal pitch as the first striker and tone generator combination and a connection from the other pole of the two-pole switch to said last identified striker, said normally open switch being movable by the respective key to close the respective circuit loop, portions of said instrument outside said circuit loop comprising a set of tilting tablets including levers corresponding respectively to each nominal pitch in the octave, each said lever being operably connected to the armature of the respective two-pole switch for the respectively similar nominal pitches, a pair of solenoids for each lever positioned adjacent the lever and operable to move said lever to tilt and return positions, a key-setting gang switch for each musical key signature having twelve individual switch points connected respectively to corresponding solenoids of said levers, three of said individual switch points being connected to tilt positioning solenoids and the remaining individual switch points being connected to return positioning solenoids, said gang switches being electrically independent of each other, and a single instantaneous button connected to each respective gang switch, said gang switch being operable by the respective button to tilt the levers corresponding to a selected musical key signature and return all others whereby to enable playing of the instrument on the single keyboard in a selected musical key at will from a standard musical score sheet without transposition.

9. A musical instrument for producing bell tones comprising a first series of sources representing the notes of a chromatic scale, each source of said series being tuned to accentuate the fundamental and the minor third thereof, a second series of sources representing a like scale, each source of said second series being tuned to accentuate the fundamental and the major third thereof, a series of key switches, circuitry interconnecting each of corresponding sources with each of said key switches, a series of stop switches, one of said stop switches being interposed between each of said key switches and a selected one only of said corresponding sources whereby a first of said sources may be substituted at will for a corresponding second of said sources.

10. A musical instrument for producing bell tones comprising a first series of sources representing the notes of a chromatic scale, each source of said series being tuned to accentuate the fundamental and the minor third thereof, said series encompassing a plurality of octaves, a second series of sources representing a like scale, each source of said second series being tuned to accentuate the fundamental and the major third thereof, said second series encompassing a plurality of octaves, a series of key switches, circuitry interconnecting each of corresponding sources with each of said key switches, a series of stop switches, one of said stop switches being interposed between each of said key switches and a selected one only of said corresponding sources, a common actuator connected to all the stop switches for corresponding fundamentals in the different octaves, whereby a first of said sources throughout all the octaves may be substituted at will for a corresponding second of said sources throughout all the octaves.

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