

[72] Inventor **John Paul Arseneault**
25 Seely Drive, Apt. 110, Downsview,
Ontario, Canada
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Primary Examiner—D. F. Duggan
Assistant Examiner—Stanley J. Witkowski
Attorney—Rogers, Bereskin & Parr

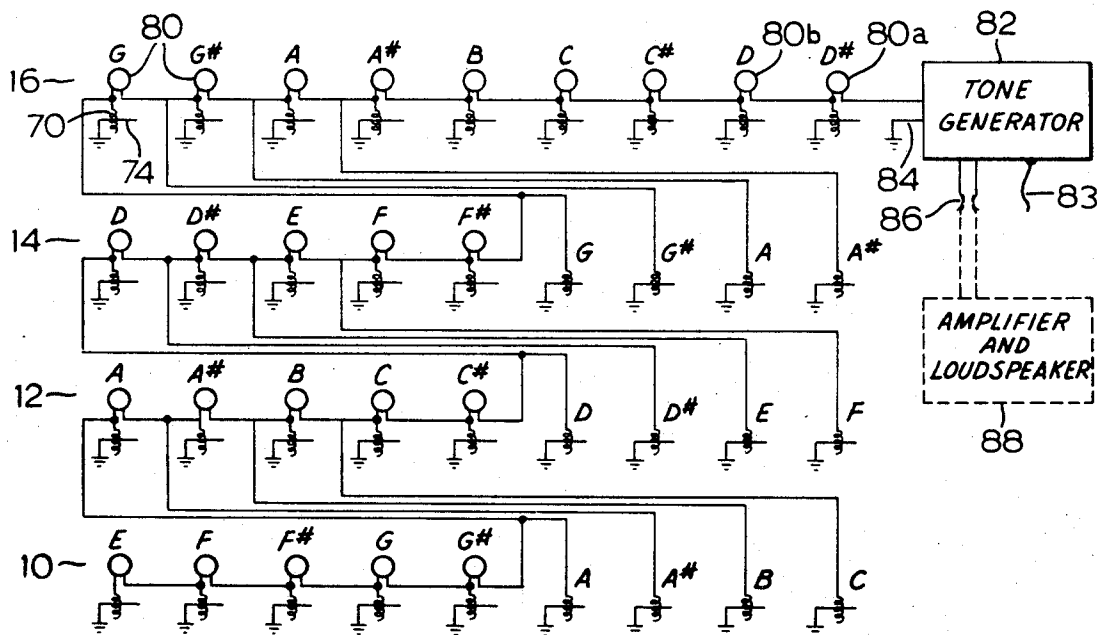
[54] **FOOT OPERATED ELECTRONIC MUSICAL INSTRUMENT**
7 Claims, 5 Drawing Figs.

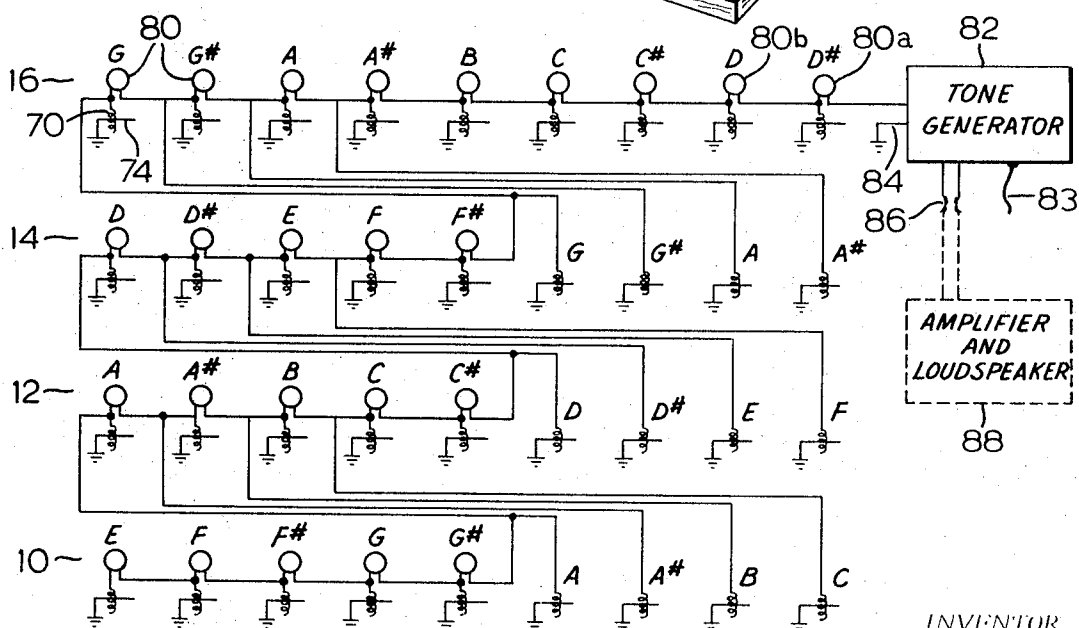
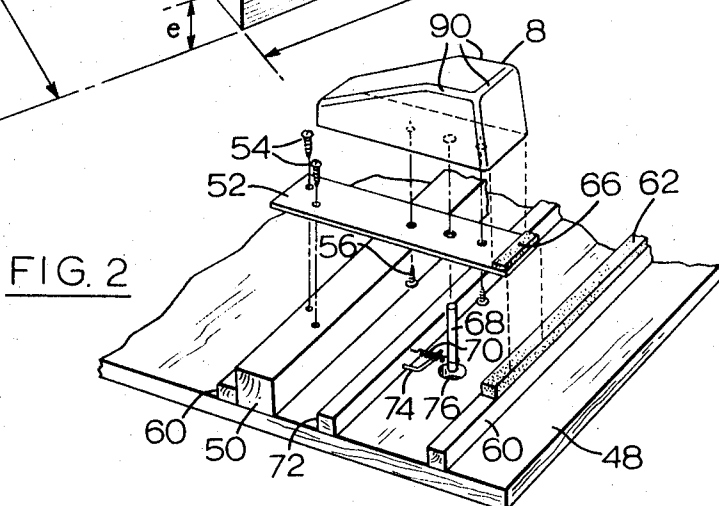
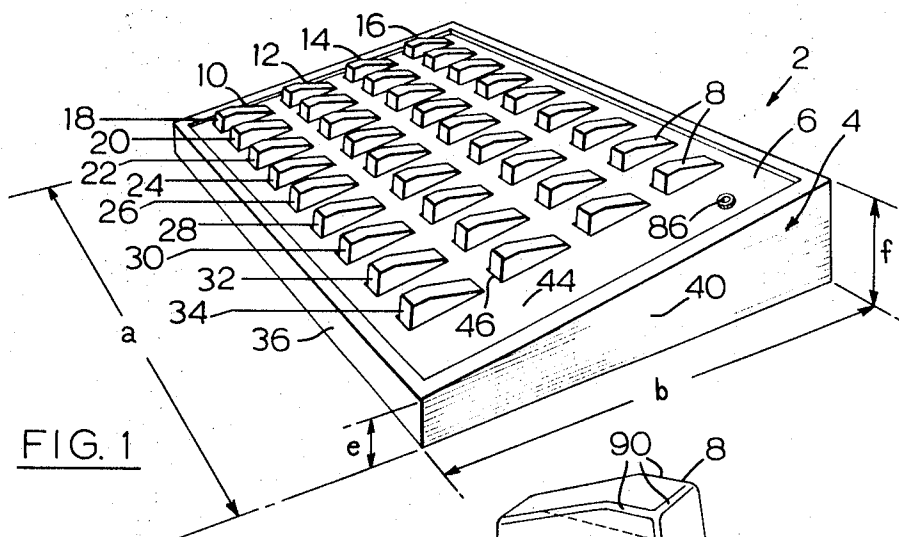
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ABSTRACT: An electronic foot operated base guitar having a thin transportable housing. Four rows of foot pedals project from the housing top and define nine evenly spaced columns. Each row corresponds to a string of a base guitar and each column corresponds to a fret. A single tone generator in the housing is activated by the highest note played. Rounded, well spaced foot pedals on spring steel mounts permit rapid, discrete foot movements.





INVENTOR,

JOHN PAUL ARSENEAULT

BY

Rogers, Bereskin, & Parr

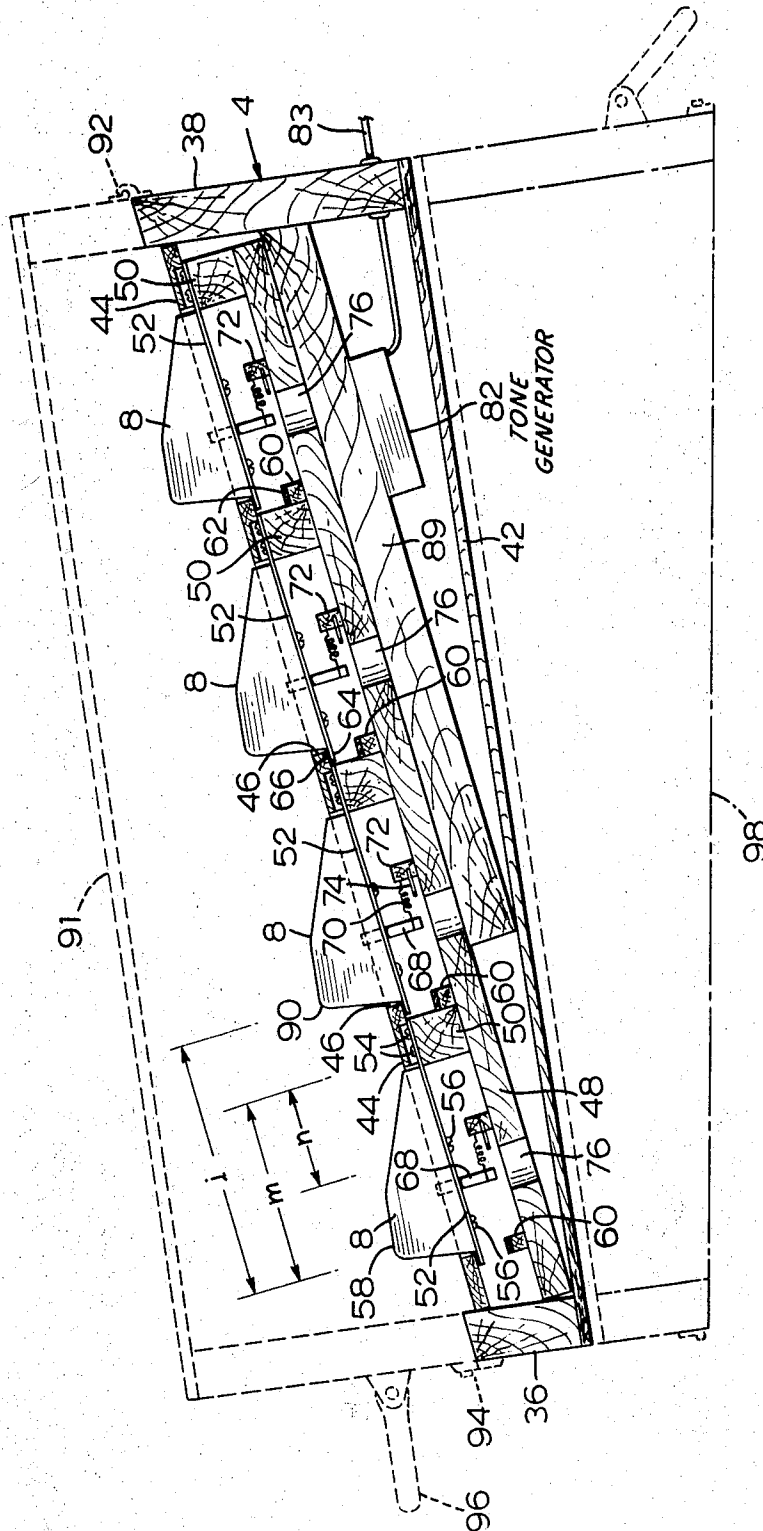


FIG. 3

INVENTOR
JOHN PAUL ARSENEAULT

BY
Rogers, Bereskin, & Parr

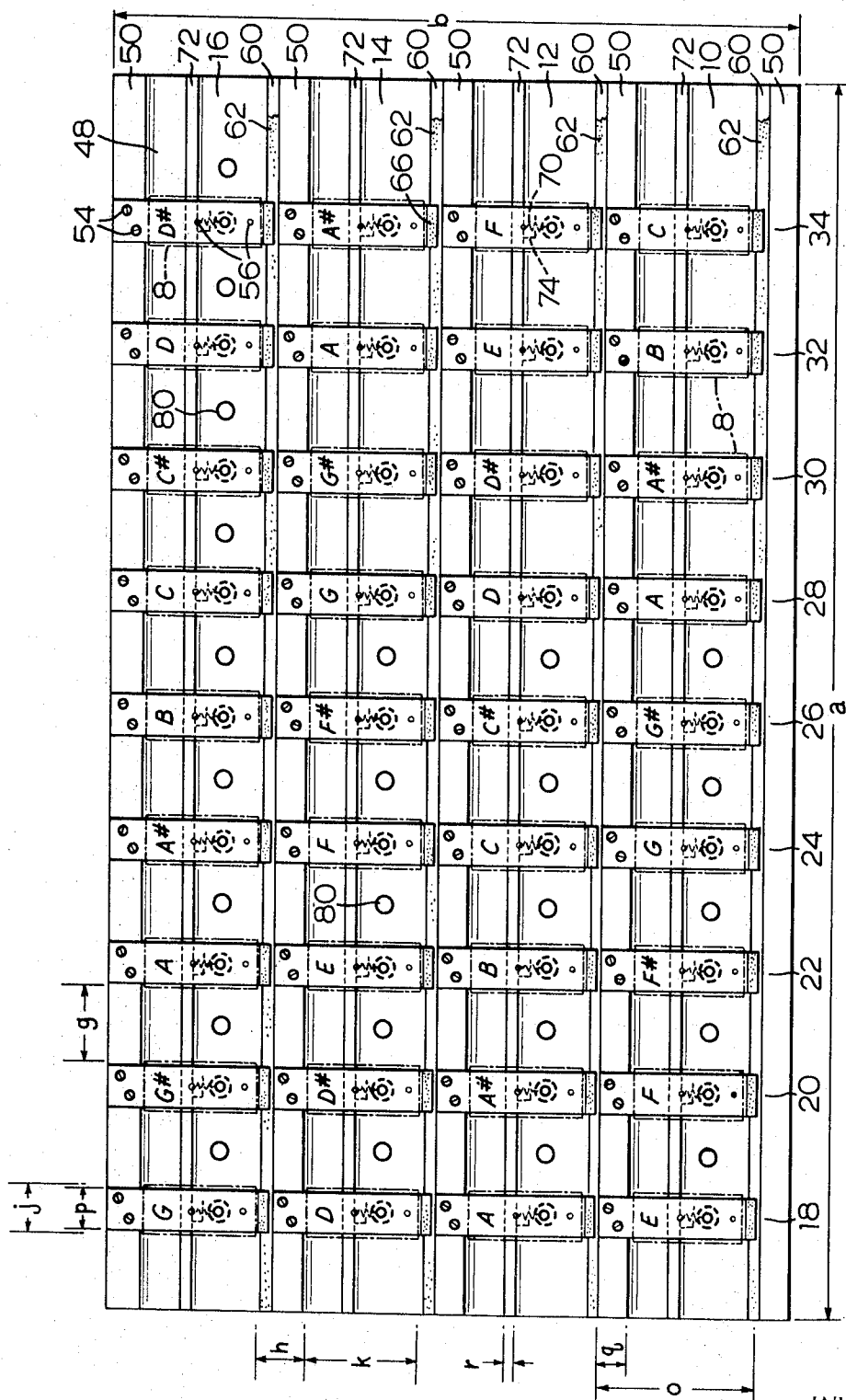


FIG. 4

INVENTOR
JOHN PAUL ARSENEAULT
BY
Rogers, Bereskin, & Parr

FOOT OPERATED ELECTRONIC MUSICAL INSTRUMENT

This invention relates to a foot operated musical instrument.

It is common in small musical groups and bands to include a bass guitarist, to provide musical pattern and accompaniment. The requirement for a separate player merely to play a bass guitar creates considerable expense. Accordingly, it is an object of the present invention to provide, in one of its aspects, a bass guitar that a player can operate easily with his feet while his hands are occupied with another instrument, thereby eliminating the need for a separate player for a bass guitar. The instrument provided by the present invention can be constructed to provide a pattern of notes different in some respects from that provided by a bass guitar, but a bass guitar is considered to be the main application for the present invention. The invention is also useful as a teaching aid in teaching musical fundamentals.

In its broadest aspect the present invention provides a foot operated musical instrument comprising:

- a. a housing having a lower portion adapted to be supported on a floor, said housing having an upper surface,
- b. foot pedals projecting from said upper surface, said foot pedals being arranged in a plurality of parallel rows, the pedals in said rows defining a plurality of columns extending at right angles to said rows, the spacing between adjacent rows being equal and the spacing between adjacent columns being equal,
- c. means yieldably mounting each foot pedal for depression of such foot pedal, including means biasing each foot pedal to an uppermost position,
- d. a plurality of sets of electrical contacts in said housing, one set associated with each foot pedal and each set operable on depression of its associated foot pedal,
- e. a plurality of circuit means in said housing, one circuit means associated with each set of contacts and being operable upon operation of its associated set of contacts, each said circuit means being adapted to cooperate with sound producing means to produce a musical note of nature dependent upon the parameters of such circuit means,
- f. the parameters of said circuit means being such that the notes produced by said sound producing means upon operation of successive foot pedals in a given row are successive notes of a chromatic scale, and the notes produced by said sound producing means upon operation of successive foot pedals in a given column are successive musical fourths one above the other.

Further objects and advantages of the invention will appear from the following description, taken together with the accompanying drawings, in which:

FIG. 1 is a perspective view of an instrument according to the invention;

FIG. 2 is a perspective view showing for one foot pedal the manner in which the foot pedals of the FIG. 1 instrument are mounted;

FIG. 3 is a side sectional view of the FIG. 1 instrument;

FIG. 4 is a top view of a main support plate of the FIG. 1 instrument, with the foot pedals shown in dotted lines; and

FIG. 5 is a circuit diagram for the FIG. 1 instrument.

Reference is first made to FIG. 1, in which a musical instrument according to the invention is shown generally at 2. As shown, the instrument includes a thin, rectangular transportable housing 4 having a sloping upper surface 6 from which project a number of foot pedals 8. The pedals 8 are arranged in four rows 10, 12, 14 and 16, each row containing nine pedals which define nine columns 18 to 34. The columns extend at right angles to the rows. The spacing between adjacent pedals in each row is equal, and the spacing between adjacent pedals in each column is equal.

Reference is next made to FIGS. 2 and 3, which illustrate details of the mechanical construction of the instrument. As shown in FIG. 3, the housing 4 includes a low front wall 36, a higher backwall 38, a pair of sidewalls 40 (FIG. 1), and a flat bottom plate 42 covering the bottom of the instrument. The

members 36 to 42 may typically be made from plywood. A cover plate 44 covers the top of the instrument and contains rectangular holes 46 for the foot pedals 8. The cover plate 44 may be covered with a decorative material such as a vinyl plastic to produce an attractive upper surface 6.

The foot pedals 8 are mounted on a main support plate 48 spaced from and extending parallel to the upper plate 44. Specifically, the main support plate 48 supports four elongated wooden strips 50, one for each row of pedals. A number of spaced strips of spring metal 52, one for each pedal, are fastened to the wooden strips 50 by screws 54. The pedals are mounted on the spring metal strips 52 by screws 56 which hold the spring strips 52 to the flat undersides of the pedals. It will be noted that each spring strip 52 extends both forwardly and rearwardly of its pedal.

The spring metal strips 52 are normally straight and hold the pedals 8 in the position shown in FIGS. 1 and 3. When a pedal 8 is depressed, its spring strip 52 is forced into a curved configuration. When the pedal is released, the spring strip 52 then returns the pedal to the position shown in FIG. 3. The pedal will normally be pressed at its highest point 58, which is spaced well forwardly of the screws 56. Because of this spacing, and because the screws 56 are also spaced well forwardly of the screws 54, the spring steel strips 52 curve gently, rather than sharply, when the pedals are depressed. This reduces stresses in the spring strips 52 and improves their performance.

To limit downward motion of the pedals 8 and to avoid damage to the spring metal strips 52, smaller wooden stop strips 60 extend along the main support plate 48 at the front ends of the pedals. The stop strips 60 are surfaced with sponge rubber (such as weather stripping) or similar sound absorbent material 62 to deaden noise when the front ends of the spring strips 52 contact the stop strips 60.

In order to limit upward movement of the pedals, the portions of the spring strips 52 which project forwardly of the pedals 8 (such projecting portions are indicated at 64 in FIG. 3) extend underneath the cover plate 44. As shown in FIG. 2, sponge rubber or similar resilient material 66 is provided on the projecting portions 64 to deaden the noise when the projecting portions 64 contact the top plate 44. Simple weather stripping has again been found to be a suitable material for this purpose.

Anchored in and projecting from the bottom of each pedal 8 is a wooden dowel 68. A series of metal contact springs 70 are provided, each connected to one of the dowels 68 and extending to a wooden contact strip 72. Each spring 70 serves as one contact of a set of contacts associated with each foot pedal. The other contact of the set of contacts is formed by an L-shaped wire 74 projecting from the wooden contact strips 72. When a foot pedal 8 is depressed, its spring 70 moves downwardly to touch its wire 74 to close the contacts. The dowel 68 is accommodated in a hole 76 in the support plate 48 at this time. The electrical contacts are provided so that when a foot pedal is depressed, it will cause production of a particular musical note, as will now be described.

The various notes produced by the pedals of the instrument being described are shown in FIG. 4. It will be seen that in each row, the successive notes are those of a chromatic scale, while in each column, each note (from front to rear) is a musical fourth above the preceding note. This is the tuning of a bass guitar, i.e. the respective rows correspond to respective strings of a bass guitar and the respective columns correspond to respective frets of the guitar. However, unlike the frets of a bass guitar, the columns 18 to 34 are evenly spaced. This results in much greater ease of play, because musical patterns (i.e. progressions or sequences of notes) can be played in any key with no change in the geometric movements required by a player's foot. For example, the sequence C (fourth note in Row 12), F (fourth note in Row 14), G (sixth note in Row 14), which is a sequence in the key of C, can be transposed to B, E, F-sharp (a sequence in the key of B), or to B-flat, E-flat, F (a sequence in the key of B-flat), with no change whatsoever in

the direction or size of movements required by a player's foot. This applies to any progressions, whether two notes or 30 notes. For example, to move up an octave from any note, one simply moves upwardly three pedals in a column and then to the right by two pedals. The same distance is required in all cases.

The manner in which musical notes are generated by the instrument will next be described, with reference to the circuit diagram of FIG. 5. As shown in FIG. 5 (and also in FIG. 4), the circuit contains a number of potentiometers 80, one for each separate note to be produced by the instrument. It will be noted in connection with FIG. 4 that the last four notes of the first three rows are identical with the first four notes of the last three rows, so that separate potentiometers are not required for the foot pedals associated with the last four notes of the first three rows.

The potentiometers 80 are all connected in series, with one end of the series connection being connected to a tone generator 82 connected to the support plate 42 of the instrument (see FIG. 3). The tone generator is energized through a conventional 110-volt power cord 83. Each spring contact 70 from the foot pedals is connected to the potentiometer representing the note that the contact is intended to initiate. Specifically, each contact is connected to the side of its potentiometer remote from tone generator 82. The other sides of the sets of contacts for the foot pedals, i.e. the wires 74, are connected to a common ground by a bus bar, not physically shown but schematically indicated at 84. The bus bar is in turn connected to the tone generator 82.

The tone generator 82 includes a power supply (not shown), an oscillator (not shown) the frequency of which depends on the resistance connected thereto, and conventional amplifying and waveforming circuits. The frequency of tones produced by the tone generator depends upon the value of the resistance switched in by the contacts of the foot pedals. For example, the contacts of the last foot pedal of row 16 switch in only one potentiometer 80a; the contacts of the second last foot pedal of row 16 switch in two potentiometers 80a, 80b in series, while the first foot pedal of row 10 switches in all of the potentiometers in series. The values of the potentiometers are chosen so that the tone generator 82 will produce the notes shown in FIG. 4 when the respective foot pedals are depressed. The waveforming circuits are made such that the quality of each note is that of a plucked string of a bass guitar in the equal temperament tuning system. If desired, a taper circuit can be included in the sound producing means so that each note sounded dies away even though the foot pedal that initiated the note remains depressed. The output of the tone generator 82 is connected to a socket 86 which may be connected to any external amplifier and speaker 88. The tone generator 82, and amplifier and speaker 88, together comprise sound producing means.

It will be noted that only one foot pedal at a time can be used. If two foot pedals are depressed at the same time, only that associated with the higher note will be operative. However, if two foot pedals are depressed at the same time and then the higher note foot pedal is released, the note associated with the lower note foot pedal will immediately sound. This makes possible extremely fast playing of the instrument. So that a player may slide his feet over the various notes rapidly, the top surface of each pedal meets the side surfaces of the pedal in rounded edges 90 that will not catch a player's feet.

The dimensions for a typical bass guitar instrument produced according to the invention are given in Table 1 below.

TABLE 1

DIMENSION	SIZE (inches)
a—(length of main support plate 48)	30
b—(width of main support plate 48)	16¾
c—(length of housing 4)	31½
d—(width of housing 4)	18
e—(height of housing front wall 36)	1½
f—(height of housing rear wall 38)	4½
g—(lateral spacing between adjacent foot pedals)	2

h—(front to rear spacing between adjacent foot pedals)	1
i—(front to rear spacing between high points of adjacent foot pedals)	4
j—(width of each foot pedal)	1½/8
k—(length of each foot pedal)	3
m—(spacing between high point of pedal and forward screw 54)	2¾/4
n—(spacing between rear screw 56 and forward screw 54)	2½/2
o—(length of spring metal strips 52)	3½/16
p—(width of spring metal strips 52)	1
q—(width of wooden strips 50)	¾/4
r—(width of wooden stop and contact strips 60, 72)	¼/4

The main plate 48 (FIG. 3) will normally be held in position in the housing by screws, not shown, and will normally be braced by a further support plate 89.

The housing will conveniently be provided with a cover 91 shown in dotted lines in FIG. 2. The cover will normally be hinged at the back by detachable hinges 92 and will be detachably connected to the front of the housing by a catch 94. In this way, the entire instrument may conveniently be carried by a handle 96 attached to the cover, and if desired, the cover can be taken off and placed beneath the instrument as shown in chain dotted lines at 98 to increase the slope of the pedals. It will be noted that the portions of the hinges 92 and the catch 94 mounted on the cover 91 are positioned above the bottom edge of the cover, so that they will be out of the way when the cover is placed on the floor.

It will be apparent that various changes can be made in the invention as described while still retaining the features of an easily portable foot operated instrument having a note layout that makes possible playing of equivalent patterns on different keys with exactly the same geometric movements. For example, the notes in the columns may be made those of a chromatic scale, and the notes in the rows may be made successive musical fourths, one above the other. The direction of progression towards higher frequencies can also be changed. For this reason, the terms column and row as here used are interchangeable, in that the rows 10 to 16 may be considered to be columns and the columns 18 to 34 may be considered to be rows. The slope of the front face of the instrument will of course depend upon which side of the instrument a player is to face, since the slope should be upwardly away from his feet to facilitate his feet reaching the various pedals. The important feature is that the notes of either the rows or the columns should be those of a chromatic scale, and the notes at right angles to those representing chromatic scales should be musical fourths above (or below) the other. This arrangement permits playing progressions in various keys without changing the direction or size of the movements between notes required for the progression. In addition, further rows or columns can be added (provided that they have the relationship to the other rows or columns described) to provide further effect.

The particular type of contact set described for the foot pedals is convenient because the contacts close part way through the downward travel of a foot pedal, and yet further downward travel of the pedal is permitted, so that the amount of downward movement required for each foot pedal is not critical. However, other types of contacts can be used. For example, each dowel 68 can be shortened and a contact button placed on its bottom, to contact a strip of spring metal extending fully in the air below the dowel from the wooden contact strip 72. Alternatively, contact buttons can be stamped from spring strips 52 and bent downwardly to contact the strips of spring metal mentioned.

The spring strip structure shown for mounting the foot pedals is not absolutely essential, but is greatly preferred because it provides an extremely simple and highly durable mounting with convenient stops to limit both upward and downward travel of the pedal. In addition, each pedal rotates slightly when it is depressed to align its top surfaces more naturally with the bottom of a player's foot, facilitating playing of the instrument.

Although the circuit for the instrument has been shown as such that only one note at a time can be played, a separate tone generator can be provided for each pedal so that more than one pedal can be depressed at a time. However, this would cause difficulty in tuning the instrument since the electrical parameters of the various tone generators tend to drift separately with changes in age and temperature. With the arrangement shown, in which all the potentiometers are connected in series, tuning the instrument is much simplified. Moreover, when only one note sounds at a time, the instrument becomes much easier and faster to play, because more than one pedal can be depressed at a time with assurance that only the higher note pedal will produce a sound, and when the higher note pedal is released, the lower note pedal will immediately initiate a note.

If desired, two tone generators can be provided, one to provide sustained tones and the other to provide tapering tones which die away with time. Both tone generators would operate upon depression of a single foot pedal, and again, only one foot pedal would be operative at a time.

In addition, if desired a ganged rotary switch can be provided to switch all the foot pedal contacts from one potentiometer to another, to shift the tuning of the instrument up or down one or more half tones, or to switch the tuning to interchange the columns and rows.

In order that the instrument may be readily portable, and so that its pedals can be conveniently reached by a player's feet, its long dimension should not exceed about 2 feet. The instrument can be condensed substantially, particularly if fewer rows and columns are provided, but the lateral spacings between the high points of pedals in a front to rear direction should not be substantially less than 2 inches (in the embodiment shown, the spacing is 4 inches), and the lateral spacings between the high points of the adjacent pedals in a side-to-side direction should also not be substantially less than about 2 inches. (In the embodiment shown, the side-to-side spacing between the centers of the high points of adjacent pedals is, from table 1, $1\frac{1}{2}$ inches plus 2 inches, i.e. $3\frac{1}{2}$ inches. It will be noted that this is very nearly equal to the front to rear spacing of 4 inches between the high points of adjacent pedals.) The width of the pedals themselves should not be less than about an inch. The presence of the tone generator 82 in the instrument improves its portability and versatility because of the ease with which the instrument can be plugged into most standard amplifier and speaker systems.

Because of its simple pedal layout and ease of use, the instrument is particularly useful for teaching transposition of chording and progressions from one key to another.

I claim:

1. A foot operated musical instrument comprising:

a. a rectangular transportable housing having lateral dimensions not exceeding substantially 2 feet by 3 feet, said housing having a pair of opposed longer sides and a pair of opposed shorter sides, a flat lower supporting surface, and a flat upper surface sloping upwardly from one of said longer sides to the other of said longer sides, said housing thereby having a lower side and an upper side,

b. foot pedals projecting from said upper surface, said foot pedals being elongated in a front to rear direction and being arranged in four parallel rows, the pedals in said rows defining a plurality of columns extending at right angles to said rows, each pedal having an upper operating area adapted to be contacted by a player's foot, the centers of the operating areas of adjacent pedals in the same column being spaced apart by a first distance, the centers of the operating areas of adjacent pedals in the same row being spaced apart by a second distance, said second distance being approximately the same as said first distance,

c. means yieldably mounting each foot pedal for depression of such foot pedal, including means biasing each foot pedal to an uppermost position, and comprising:

1. a flat strip of spring metal beneath said foot pedal and having forward and rearward projections extending respectively forwardly and rearwardly of said foot pedal,

2. first fastening means fastening said strip to the underside of said pedal,

3. second fastening means fastening said rearward projection to said housing, said first and second fastening means being spaced substantially apart and said pedal being shaped so that said operating area thereon is spaced substantially from said second fastening means, so that when said pedal is depressed, said strip will curve to allow a rolling pedal motion and when said pedal is released, said strip will return said pedal to its uppermost portion,

4. and a stop mounted on said housing and extending over said forward projection of said strip, to limit upward motion of said pedal,

d. a plurality of sets of electrical contacts in said housing, one set associated with each foot pedal and each set operable on depression of its associated foot pedal, each set of contacts having first and second contact surfaces, and means mounting said contact surfaces so that one such surface will wipingly engage the other when its associated pedal is depressed,

e. a plurality of circuit means in said housing, one circuit means associated with each set of contacts and being operable upon operation of its associated set of contacts, each said circuit means being adapted to cooperate with sound producing means to produce a musical note of nature dependent upon the parameters of such circuit means,

f. the parameters of said circuit means being such that the notes produced by said sound producing means upon operation of successive foot pedals in a given row are successive notes of a chromatic scale, and the notes produced by said sound producing means upon operation of successive foot pedals in a given column are successive musical fourths one above the other,

g. the notes of said first column being, from the low side of said housing to the high side of said housing, E, A, D and G.

2. An instrument according to claim 1 wherein the notes associated with the foot pedals in the row adjacent said lower side are E, F, F-sharp, G, G-sharp, A, A-sharp, B, and C, progressing from left to right with a player facing said lower side.

3. An instrument according to claim 1 including means interconnecting each set of contacts one with the other for operation of a set of contacts associated with a foot pedal representing one note to disable operation of the circuit means of all the sets of contacts associated with foot pedals representing lower notes.

4. A foot operated musical instrument comprising:

a. a rectangular transportable housing having lateral dimensions not exceeding substantially 2 feet by 3 feet, said housing having a pair of opposed longer sides and a pair of opposed shorter sides, a flat lower supporting surface, and a flat upper surface sloping upwardly from one of said longer sides to the other of said longer sides, said housing thereby having a lower side and an upper side,

b. foot pedals projecting from said upper surface, said foot pedals being arranged in four parallel rows, the pedals in said rows defining a plurality of columns extending at right angles to said rows, each pedal having an upper operating area adapted to be contacted by a player's foot, the centers of the operating areas of adjacent pedals in the same column being spaced apart by a first distance, the centers of the operating areas of adjacent pedals in the same row being spaced apart by a second distance, said second distance being approximately the same as said first distance,

- c. means yieldably mounting each foot pedal for depression of such foot pedal, including means biasing each foot pedal to an uppermost position,
- d. a plurality of sets of electrical contacts in said housing, one set associated with each foot pedal and each set operable on depression of its associated foot pedal,
- e. a plurality of circuit means in said housing, one circuit means associated with each set of contacts and being operable upon operation of its associated set of contacts, each said circuit means being adapted to cooperate with sound producing means to produce a musical note of nature dependent upon the parameters of such circuit means,
- f. the parameters of said circuit means being such that the notes produced by said sound producing means upon operation of successive foot pedals in a given row are successive notes of a chromatic scale, and the notes produced by said sound producing means upon operation of successive foot pedals in a given column are successive musical fourths one above the other,
- g. the notes of said first column being, from the low side of said housing to the high side of said housing, E, A, D and G,
- h. said instrument including a cover for said housing, said cover being rectangular and having a pair of opposed longer sides, a pair of opposed shorter sides, and a flat top surface, the height of said cover being substantially less at one of its longer sides than at the other of its longer sides so that when said cover is positioned on said housing, the combined height of said cover and said housing is the same at each of said longer sides, and cooperating connecting means on said cover and on said housing for detachably connecting said cover to said housing, said connecting means on said cover being located above the bottom edge of said cover so that said cover can be

removed from said housing and positioned on a floor with its bottom edge resting on said floor, and said housing can be positioned on said cover with the lower side of said housing resting on the lower side of said cover, thereby increasing the slope of the upper surface of said housing.

5. An instrument according to claim 4 wherein said means

(c) comprises for each foot pedal:

1. a flat strip of spring metal beneath said foot pedal and having forward and rearward projections extending respectively forwardly and rearwardly of said foot pedal,
2. first fastening means fastening said strip to the underside of said pedal,
3. second fastening means fastening said rearward projection to said housing, said first and second fastening means being spaced substantially apart and said pedal being shaped so that the highest point thereon is spaced substantially from said second fastening means, so that when said pedal is depressed, said strip will curve to allow pedal motion and when said pedal is released, said strip will return said pedal to its uppermost position,
4. and a stop mounted on said housing and extending over said forward projection of said strip, to limit upward motion of said pedal.

6. An instrument according to claim 4 wherein the notes associated with the foot pedals in the row adjacent said lower side of said housing are E, F, F-sharp, G, G-sharp, A, A-sharp, B and C, progressing from left to right with the player facing said lower side.

7. An instrument according to claim 4 including means interconnecting each of said contacts one with the other for operation of a set of contacts associated with a foot pedal representing one note to disable operation of the circuit means of all the sets of contacts associated with the foot pedals representing lower notes.

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