Oct. 4, 1949. J. E. BRADLEY 2,483,617

MUSICAL INSTRUMENT

Filed May 14, 1947 5 Sheets-Sheet 1

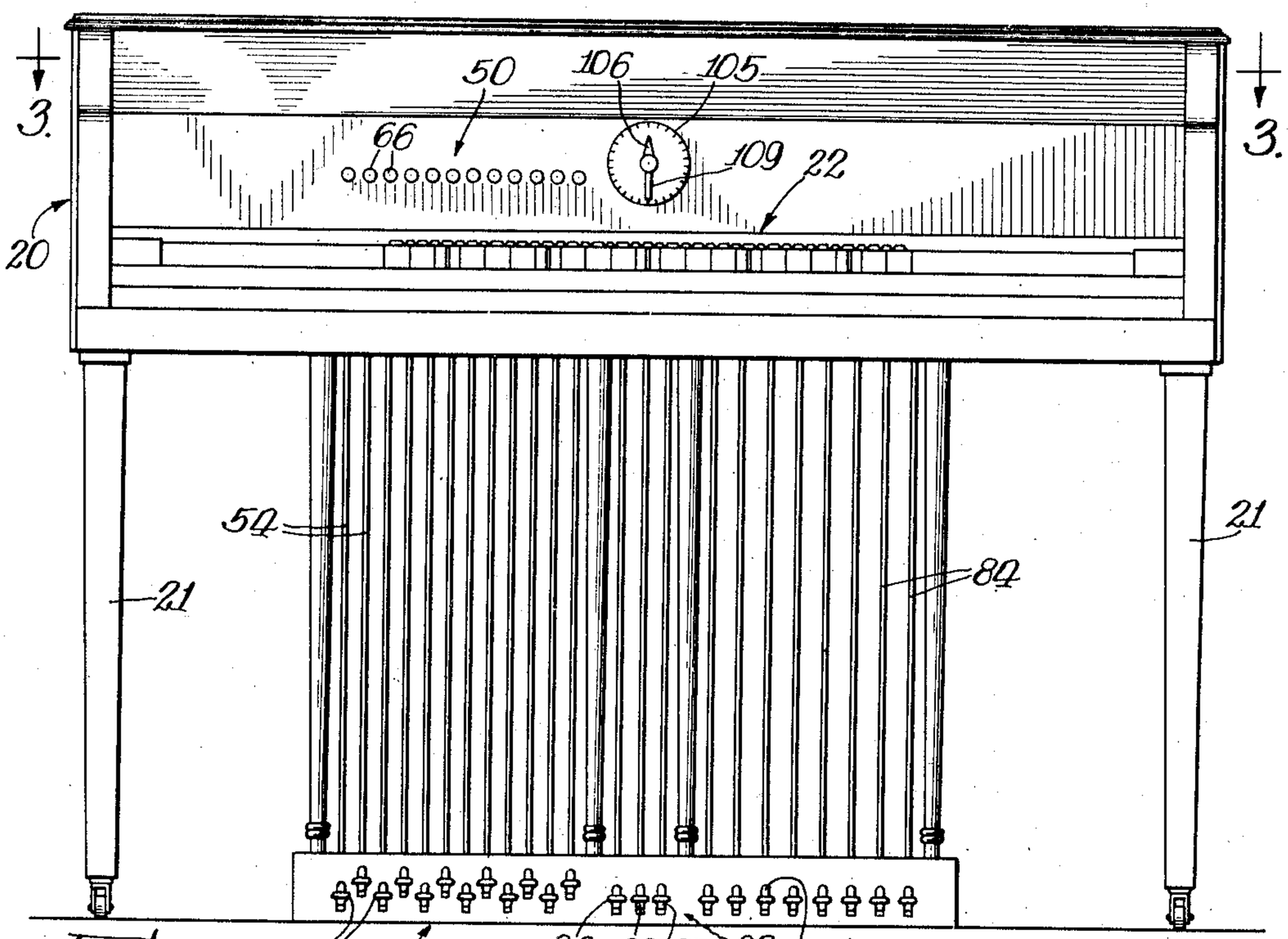

Fig. 1.

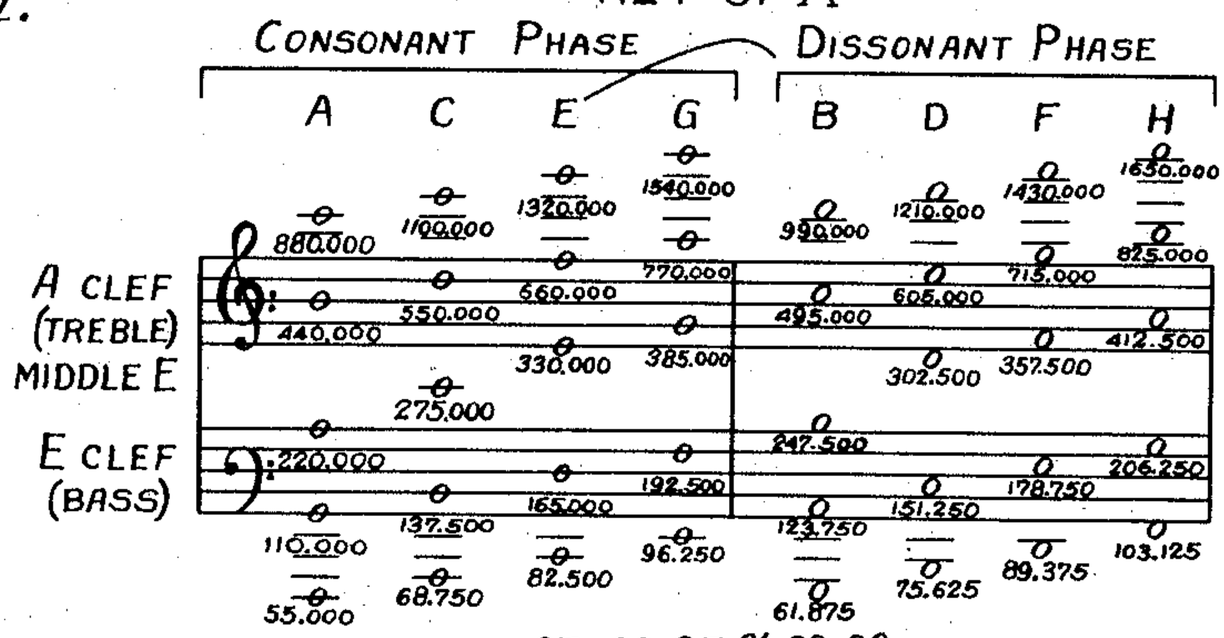

Fig. 9.

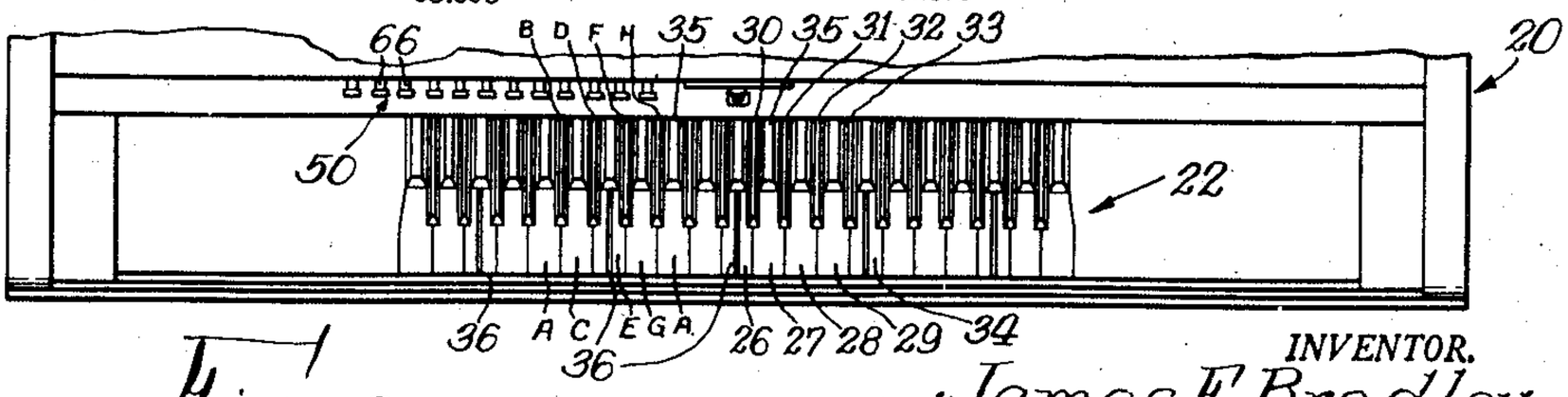

Fig. 2.

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Oct. 4, 1949. J. E. BRADLEY 2,483,617

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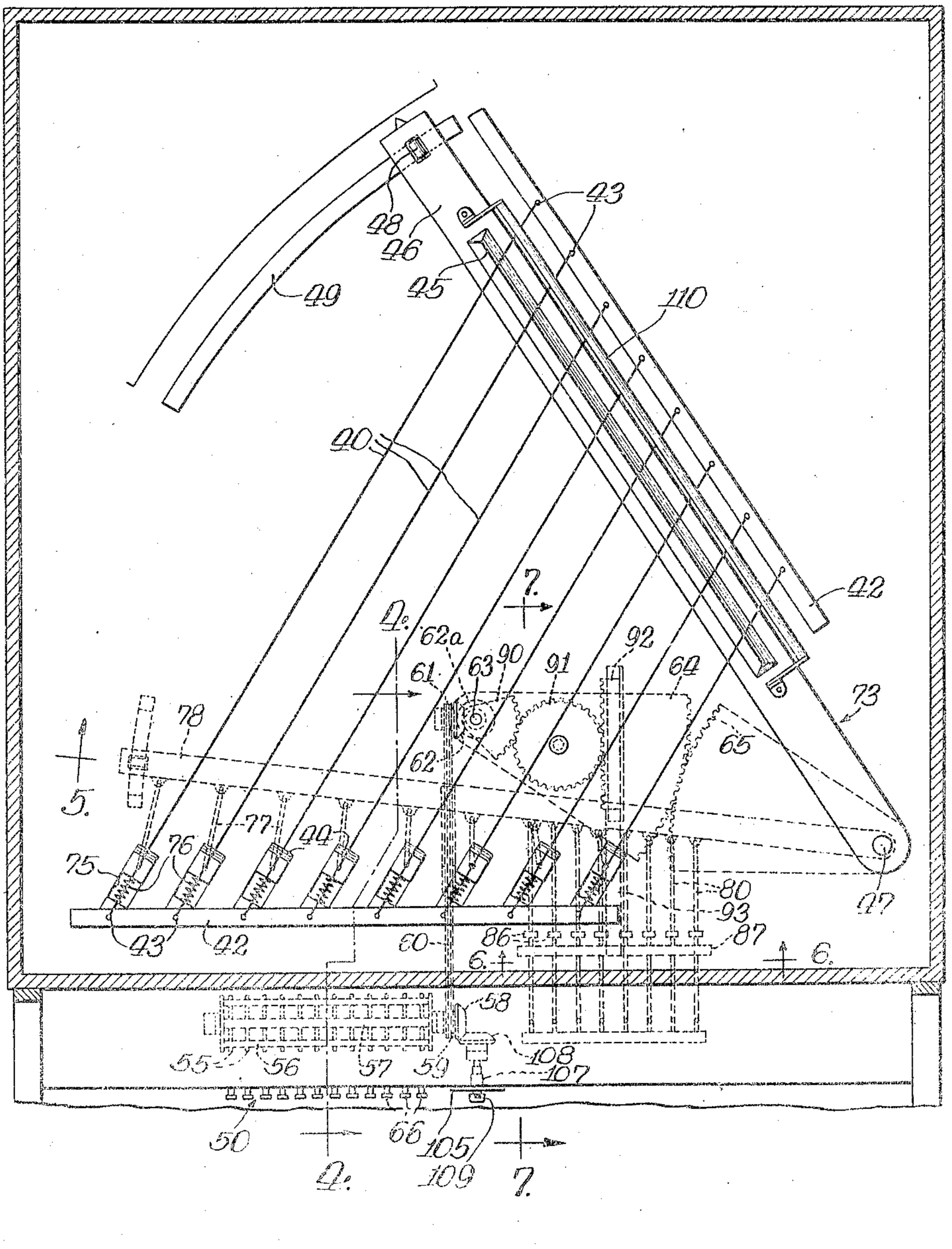
Fig. 3.



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Oct. 4, 1949. J. E. BRADLEY 2,483,617

MUSICAL INSTRUMENT

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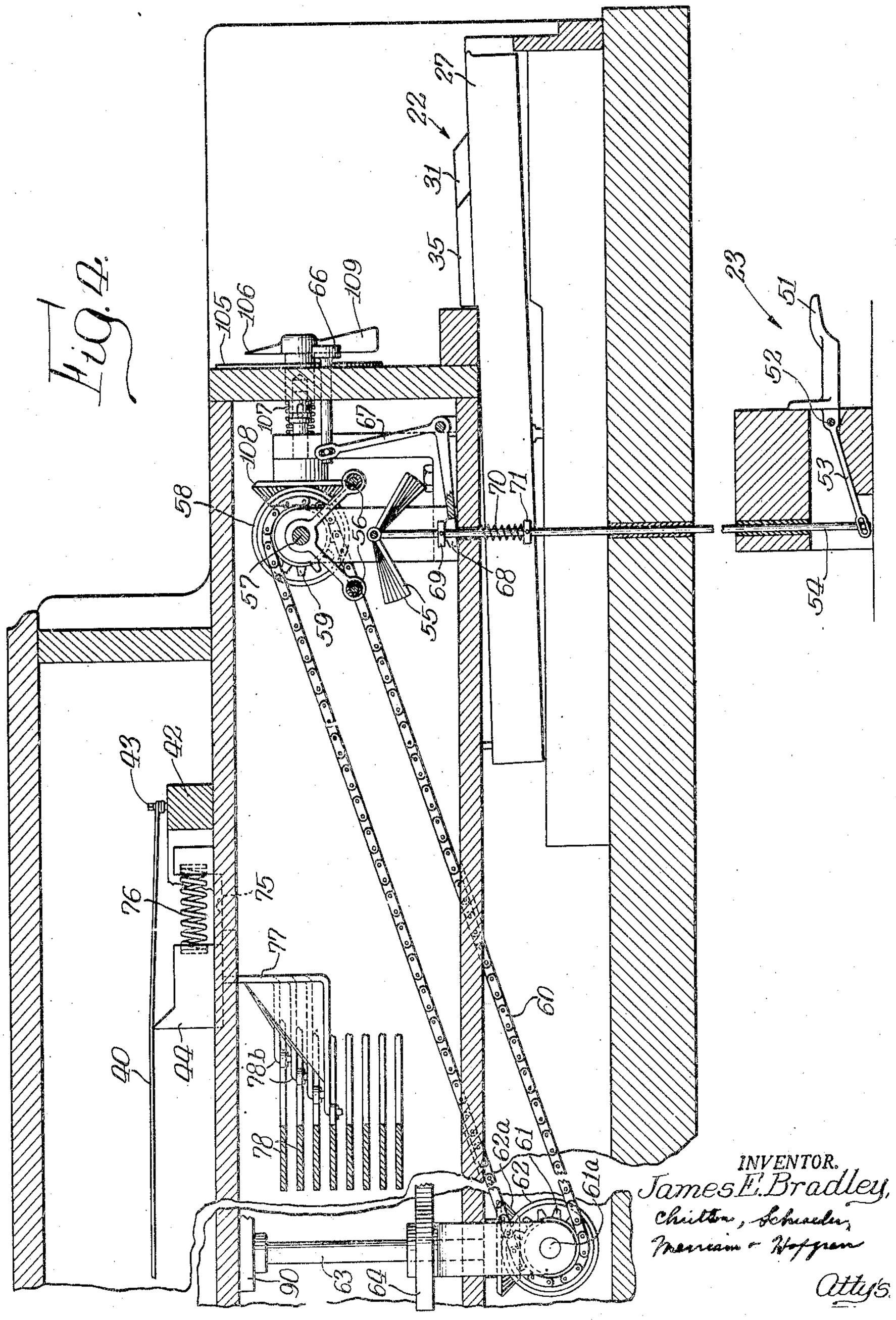
Fig. 4.



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Oct. 4, 1949. J. E. BRADLEY 2,483,617

MUSICAL INSTRUMENT

Filed May 14, 1947 5 Sheets-Sheet 4

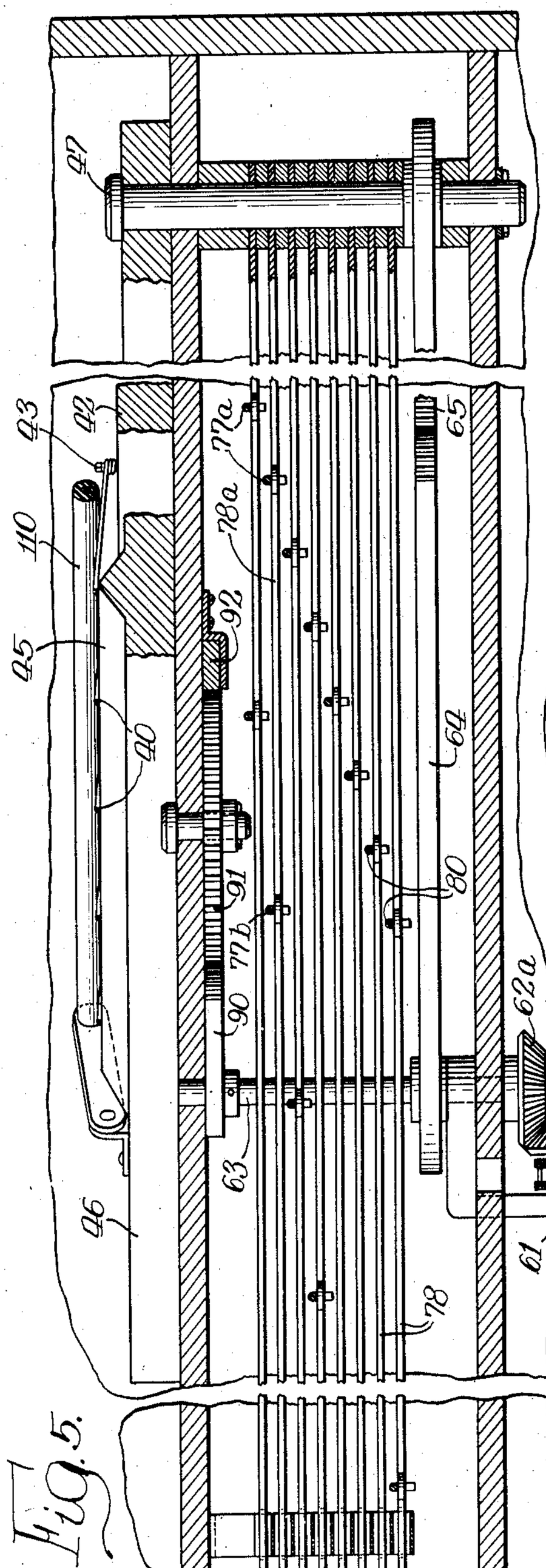

Fig. 5.

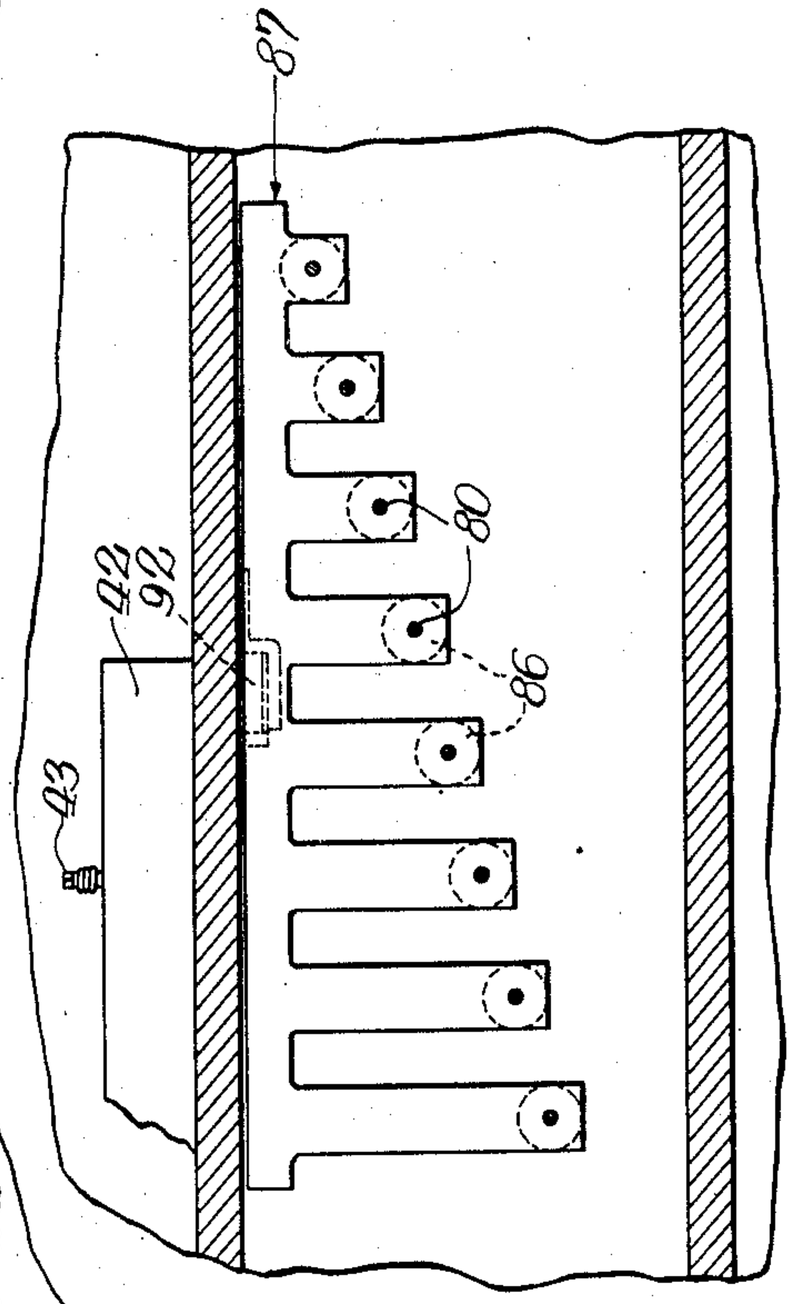

Fig. 6.

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MUSICAL INSTRUMENT

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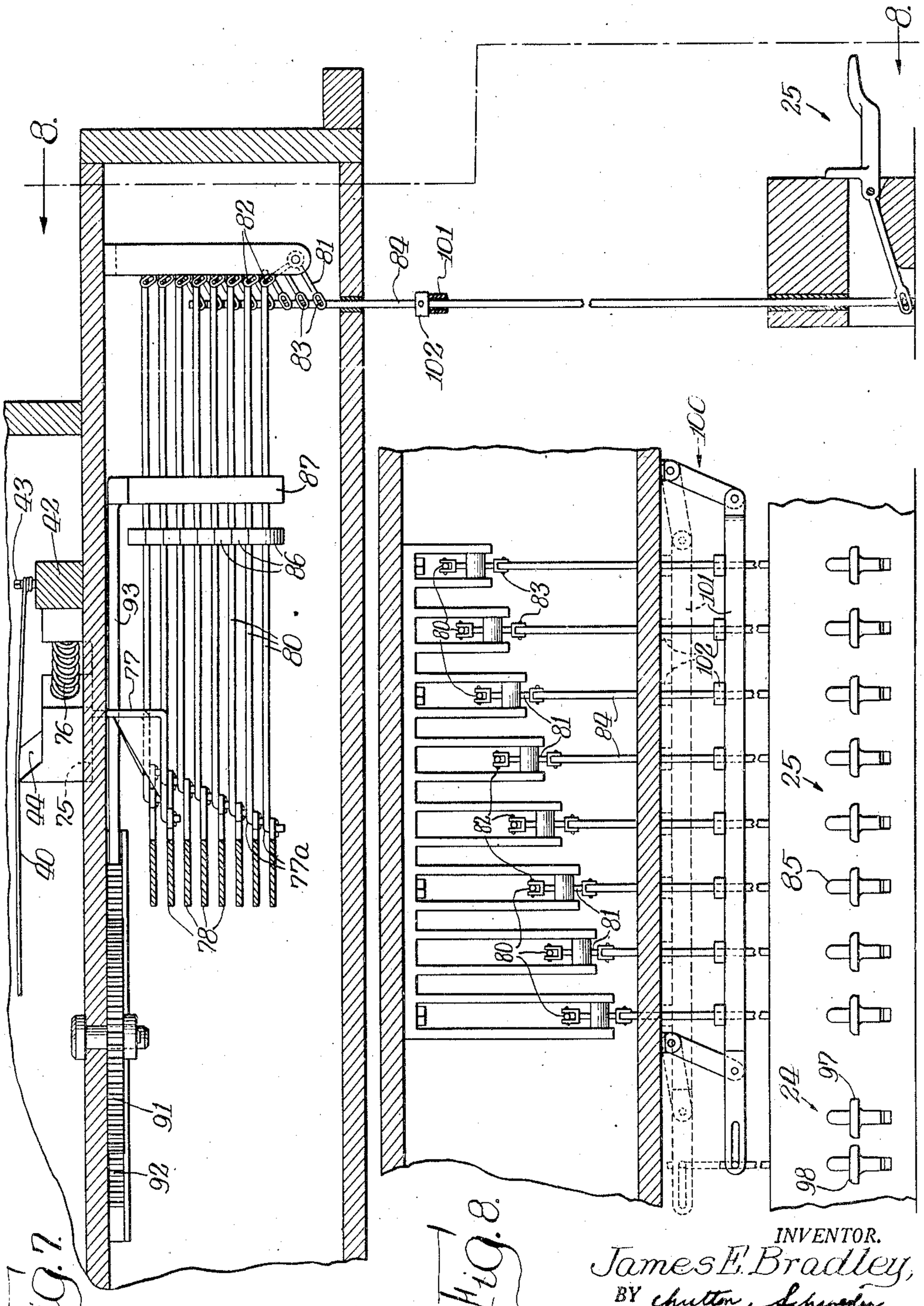

Fig. 7.

Fig. 8.

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Patented Oct. 4, 1949 2,483,617

UNITED STATES PATENT OFFICE

2,483,617

MUSICAL INSTRUMENT

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Application May 14, 1947, Serial No. 747,941

19 Claims. (Cl. 84—312)

1

This invention relates to a musical instrument, and more particularly to a stringed musical instrument of the piano type having increased musical versatility.

While this invention may be embodied in many types of musical instruments, it will be herein described as embodied in a stringed musical instrument of the piano or pianoette type. I declare the following to be a full, clear and exact description of this invention, such as will enable those skilled in the art to which it appertains to make and use the same.

It is well known in the field of music that the greatest clarity of tone is obtained only when the instrument possesses true pitch, that is, when the instrument is so tuned that each succeeding note of the scale differs from the preceding note by equal proportionate fractions of divisions of an octave. The strings of the ordinary piano, however, are not tuned in true pitch, but rather in a tempered pitch. This tempered pitch is employed so that the number of keys on a piano may be held to a workable minimum and yet permit the instrument to be played in various keys. There are numerous methods of tuning to achieve this tempered scale, all of which have the same basic idea just expressed.

My invention embraces a stringed musical instrument in which the strings are tuned in true pitch and yet permits the instrument to be played in any chosen key while maintaining the strings in true pitch with relation to each other.

For example, the table below shows a sample octave in the key of A, and lists the number of vibrations per second of each string in the octave when tuned in one form of tempered pitch and as tuned in true pitch in my instrument.

Tempered scale

A	110
B	123.471
C#	138.591
D	146.832
E	164.814
F#	184.997
G#	207.652
a	220.000

True pitch

A	110
B	123.750
C	137.500
D	151.250
E	165.000
F	178.750
G	192.500
H	206.250
a	220.000

It will be noted from the above table that in the true pitch scale shown, an octave from A to

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a is divided into eight notes, each differing from the preceding or succeeding note by one-eighth of the difference between A and *a*.

The manner in which changes of key are permitted and the versatility of my instrument can best be seen from the accompanying drawings in which:

Fig. 1 is a front view of a piano type instrument showing a portion of the keyboard and the pedal bank;

Fig. 2 is a top elevation of the instrument of Fig. 1;

Fig. 3 is a plan view of the framework and strings of the instrument together with many of the working parts;

Figs. 4, 5 and 7 are vertical sections along lines 4—4, 5—5 and 7—7 of Fig. 3;

Fig. 6 is an enlarged detail view of the stop means for the sub tone pedals;

Fig. 8 is a vertical section along lines 8—8 of Fig. 7; and,

Fig. 9 is a view of sample clefs designed for use with the instrument.

Referring now to the drawings, **20** indicates a musical instrument of the piano type supported on legs **21** having a keyboard **22** and three banks of pedals **23**, **24** and **25**. As best seen in Fig. 2, the keyboard **22** comprises a plurality of keys, there being eight keys to the octave. I prefer to construct the keys of white and black material as in the usual piano to aid in distinguishing them from each other, but it will be noted that the keyboard **22** is not in the usual form found on pianos. To further explain this keyboard, a sample octave will be selected which includes the white keys **26**, **27**, **28** and **29** and the black keys **30**, **31**, **32** and **33**. The white key **34** just above the white key **29** is adapted to strike the strings of the instrument which are tuned one octave above those struck by the key **26**. The black keys are in the usual form, that is, raised above the front portion of the white keys, but the white keys have a rear portion **35** (that is, a portion closest to the backboard of the instrument), which is raised so as to be flush at the rear with the black keys. In this manner, the rear portion of all the keys are flush with each other thereby permitting the instrument to be played more rapidly and with greater ease than in the conventional keyboard. As each white key is preceded and followed by a black key, and as all the white and black keys are symmetrically arranged and are identical in appearance, it is necessary that identifying means such as the ridge **36** be supplied upon keys an octave apart in order that they may be identified.

For ease of explanation, I have lettered the keys in one octave from A to H. The strings struck by each key are tuned in absolute pitch, and represent the octave A to H of the harmonic major scale. The white keys A, C, E and G represent

the 8th, 10th, 12th and 14th harmonics of the generating tone and are the consonant phase of the key in any position. The black keys B, D, F and H represent the 9th, 11th, 13th, and 15th harmonics of the generating tone and are the dissonant phase of the key in any position.

Depression of the keys is adapted to cause a hammer to strike the strings **40** of the instrument in the usual manner. The strings are secured to the framework **42—42** of the instrument in the usual manner, such as by pegs **43**. One end of the strings (the lower end as seen in Fig. 3), is determined by contact with the frets **44** while the other end of the strings shown in the lower portion of that figure is determined by contact with a tongue **45** mounted on the bridge **73**. The bridge includes a sound box **46** and the entire assembly is movable about a pivot **47** thereby to vary the lengths of the strings. The bridge assembly **73** is provided with a roller **48** adjacent the end opposite the pivot, which roller is adapted to roll in a guideway **49** to facilitate movement of the bridge. A rubber roller **110** is attached to the bridge assembly to prevent vibration of that part of the strings on the other side of the tongue **45**. As can be seen in Fig. 3, the fret means **44**, which determine the lower end of the strings, are on a line which, if projected, would intersect the pivot point **47**. Being so mounted, movement of the bridge about its pivot varies the length of all strings proportionately and raises or lowers the pitch of all the strings to change the key without disturbing the tonal relationship of the strings.

In the embodiment shown, I have provided for movement of the bridge to twelve predetermined positions corresponding to twelve different keys in equal temperament in which the instrument may be played. Movement of the bridge to such positions may be achieved manually through the levers **50** mounted upon the front of the instrument or by the first bank of pedals **23**. The various keys in which the instrument may be played by such movement of the bridge are arranged in perfect fifths, upward, for example A, E, B, F#, C#, G# or A^b, E^b, B^b, F, C, G and D. Actuation of the proper lever **50** or depression of the proper pedal in the first bank **23** is adapted to move the bridge to vary the length of the strings so that the instrument then may be played in the key desired. By this arrangement, the same key, for example the ridged key on the keyboard, becomes the dominant note of the scale for whatever major key in which the instrument is played. It is, therefore, unnecessary that various fingerings be learned to play the instrument in various major keys, the same fingering being employed for all major keys.

As best seen in Fig. 4, depression of one of the pedals **51** in the bank of pedals **23** rocks a bell crank arrangement, which is pivoted at **52**, to raise the arm **53**, the arm being connected to a rod **54** extending up into the interior of the instrument. The upper end of the rod is provided with a cam arrangement **55** which, upon being raised, strikes a cradle **56** to cause rotation of a rod **57** in a clockwise or counterclockwise direction and in an amount determined by an angle at which the cam **55** is set. A gear **58** is attached to the rod **57** as is a spur gear **59**. A chain **60** extends from the gear **59** to a second spur gear **61** mounted on a rotatable shaft **61***a*. A beveled gear **62** is also mounted on the shaft **61***a* which engages another beveled gear **62***a* mounted upon

a vertical shaft **63**. Rotation of the shaft **63** is adapted to cause rotation of a gear segment **64** mounted thereon whose teeth mesh with the teeth of a second gear segment **65** connected to the bridge assembly.

As previously stated, movement of the bridge may also be obtained manually by means of the levers **50**. Referring to Fig. 4, one of such levers, **66**, is shown, which lever is connected to a bell crank arrangement **67**. The inner end of the bell crank is provided with an annular device **68** surrounding the rod **54** and adapted to engage a washer **69** affixed to the rod to lift the cam **55** upward against the cradle **56**. A spring **70** is interposed between the lower portion A of the frame and a washer **71** to return the rod **54** and hence the pedal **51**, lever **66** and cam **55** to the position shown in Fig. 4 after such cam has made contact with the cradle **56**, that is, upon release of the lever or pedal.

Similar cam arrangements are provided for each of the other eleven pedals and levers shown to permit movement of the bridge to set up any desired key.

Means are provided for subbing the tone of any of the strings regardless of the position of the bridge means. In the embodiment shown, the pedals in bank **25** are sub tone pedals arranged, by a series of rods and levers, to move selected frets **44** in a direction lengthening the string and thereby subbing its tone.

As best seen in Figs. 4, 5 and 7, each of the frets **44** is mounted in an individual guideway **75** in which it may be moved to the right (as seen in that figure) to lengthen the string **40**. Spring means **76** are adapted to return the fret to its normal position. Movement of the fret to achieve a sub tone is accomplished by means of one of a plurality of right angular rods **77** having one end attached to the fret and having the other end pivotally connected to one of eight movable arms **78**. As can be seen from the figures, each arm is individually movable about the pivot **47**, and each arm is connected to the frets which are associated with strings an octave apart. For example, one of the arms **78***a* may be assumed to be associated with the A strings and is connected by means of rods **77***a* and **77***b* to all frets determining strings tuned to A, although octaves apart. The other arms are likewise connected to all the B's, all the C's, etc. It can be seen then that movement of the arm **78** by means of the right angular rod **77** moves all the frets associated with strings differing by an octave in a direction to lengthen the strings and, therefore, sub the tones.

Movement of each of the arms **78** about its pivot **47** is achieved by a plurality of rods **80** connected to each of said arms and connected to a bell crank **81** adjacent the keyboard end of the instrument. A bell crank **81** is provided for each of the rods **80** and is connected thereto by means of a link **82** and connected by means of a second link **83** to a vertical rod **84**. Depression of one of the pedals **85** in the bank **25** is adapted to cause upward movement of the rod **84** and hence outward movement of the particular rod **80** associated with that pedal. Stop means **86** are connected to each of the rods **80**, which stop means are adapted to strike against a stop **87** thereby to limit the movement of the rods **80** and hence the subbing movement of the frets **44**.

The amount of movement of the frets **44** to accurately sub any particular note or tone varies

with the particular key in which the instrument is being played. In other words, the amount of movement permitted to the rods **80** upon depression of any pedal in the bank **25** must vary with the position of the bridge **73**. Means are therefore provided to change the position of the stop **87** with changes in positions of the bridge.

Mounted upon the shaft **63** is a gear segment **90**, adapted to be rotated with rotation of the shaft **63**, and meshing with a gear **91**, which gear in turn meshes with a rack **92**. A shaft **93** has one end connected to the rack **92** and is attached at the other end to the stop **87**. It can be seen then, that rotation of the shaft **63** is adapted not only to move he bridge means to various predetermined positions, but simultaneously shifts the stop **87** thereby to vary the permissible movement of rods **80**. The amount of movement permitted the rods **80** is so determined as to properly and accurately sub the tone of each string in any position of the bridge means.

The position of the sub tone pedals in the bank **25** may be varied at will, however, I prefer to arrange the pedals so that the pedal subbing those tones which are most commonly subbed are more conveniently placed. In such an arrangement, the first pedal would sub all the H's, the second the C's, and the following pedals the G's, D's, E's, F's, B's and A's in that order.

In the central bank of pedals **24**, three pedals are shown, the left hand pedal **96** being the soft pedal commonly found on pianos, while the right hand pedal **97** is the loud pedal. The central pedal **98** is adapted to sub all the tones of the instrument, this being achieved through a parallelogram arrangement **100** connected to the pedal **98** and connected to a bar arrangement **101** which encloses all of the rods **84**. Depression of the pedal **98** causes the bar **101** to move upwardly against washers **102** affixed to each rod **84** and thereby to move all the rods **84** upwardly. All the frets **44** are shifted in a direction lengthening all strings and subbing all the tones simultaneously by depressing pedal **98**.

The various positions of the bridge as set by either the pedals or the levers may be visually indicated upon the face of the instrument by means of a dial **105** and a pointer arrangement **106**. The pointer is connected to a shaft **107** and is provided with a lever **109** in order that the bridge may be moved manually a slight amount either way for accuracy of adjustment or to provide for quarter tone intervals. Attached on the inner end of the shaft **107** is a beveled gear **108** meshing with the beveled gear **58**, and therefore rotation of the shaft **107** is adapted to cause movement of the bridge **73**.

This instrument, having an additional tone H added to the scale in common use, requires a provision for representing this tone. This is done by adopting new clefs for the instrument, that is, clefs that distinguish this particular instrument's notation from that of the ordinary piano. Piano music, however, may be conveniently arranged for and played on my new instrument. Fig. 10 shows the A and E clefs adapted for this instrument. The notes are shown on the clefs and the number of vibrations of each tone is shown in philharmonic pitch, the consonant tones being on the lines and the dissonant tones on the spaces. A dot may immediately precede any note to indicate that that note is to be subbed.

While I have shown and described my invention in its preferred embodiment, that is, described in a piano of the "grand" type in which the strings are horizontal, it is to be understood that it is capable of many modifications. For example, the invention could be embodied in a piano of the "upright type." Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. In a stringed musical instrument, a plurality of strings parallelly arranged, a bridge movable about a pivot, said bridge determining one end of said strings, fret means determining the other ends of said strings, said fret means lying on a line passing through said pivot and means for moving the bridge about said pivot to change the pitch of said strings.

2. The instrument of claim 1 including pedal and manual means for moving said bridge.

3. The instrument of claim 1 including a sound box attached to said bridge.

4. In a stringed musical instrument, a plurality of strings parallelly arranged and tuned in true pitch with respect to each other; a bridge movable about a pivot, said bridge having a first portion determining one end of said strings and having a second portion including a sound box attached to said first portion; fret means determining the other ends of said strings, said fret means lying on a line passing through said pivot, and means for moving said bridge a predetermined amount about said pivot to vary the length of said strings while maintaining each of said strings in true pitch with respect to the rest of said strings.

5. The musical instrument of claim 4 in which said frets are movable and including pedal means for moving said frets a predetermined distance to sub the tones of each of said strings.

6. In a stringed musical instrument, a plurality of strings parallelly arranged, a bridge movable about a pivot, said bridge determining one end of said strings, fret means determining the other end of said strings, said frets lying on a line passing through said pivot, said fret means being individually movable to vary the length of said strings whereby to sub the tones thereof, means for moving said frets, said means being mounted for movement about said pivot, and means for moving said bridge to uniformly change the pitch of all of said strings.

7. The stringed instrument of claim 6 including stop means for limiting the motion of said fret means, said stop means being operatively associated with said bridge whereby movement of said bridge is adapted to move said stop means to correlate the distance of movement of said frets with the pitch of the strings as determined by the position of said bridge.

8. In a stringed musical instrument, a plurality of strings parallelly arranged, said strings being tuned in true pitch with respect to each other and eight of said strings defining an octave, a bridge movable about a pivot, said bridge determining one end of said strings, fret means determining the other end of said strings, said fret means lying on a line passing through said pivot, means for moving said bridge to change the pitch of said strings, and a plurality of keys arranged in a keyboard, each of said keys being adapted to sound one of the strings when the key is actuated.

9. The musical instrument of claim 8 in which eight of said keys define an octave, and each octave includes 4 white keys and 4 intermediate

black keys shorter than the white keys, said black keys having a portion raised above the front portion of the white keys and the white keys having a rear portion flush with and equal in width to the rear portion of the black keys.

10. In a stringed musical instrument, a keyboard including a plurality of keys, each of said keys being adapted to sound at least one of said strings upon being depressed, said instrument having eight strings to an octave, and said keyboard having eight keys to an octave including 4 white keys and 4 black keys between and shorter than the white keys, the rear portion of all of said keys lying in substantially the same plane.

11. The keyboard of claim 10 including identifying means on at least one key of each octave.

12. In a stringed musical instrument, a plurality of strings parallelly arranged, a bridge movable about a pivot, said bridge determining one end of said strings, a plurality of frets determining the other end of said strings each of said frets lying on a line passing through said pivot, each of said frets determining one end of at least one of said strings and every ninth fret determining strings adapted to vibrate an octave apart, means for simultaneously moving all frets determining strings tuned an octave apart, and means for moving the bridge about said pivot to change the pitch of said strings.

13. The stringed instrument of claim 12 including stop means for determining the distance said frets are moved whereby to sub the tones of said notes, said stop means being operatively associated with said bridge whereby changes of position of said bridge is adapted to cause changes of position of said stop means.

14. The stringed instrument of claim 12 including means for simultaneously moving all frets to sub the tones of all the strings.

15. In a stringed musical instrument, a plurality of strings parallelly arranged and tuned in true pitch with respect to each other, a bridge movable about a pivot, said bridge determining one end of said strings, a plurality of frets determining the other end of said strings, each of said frets lying on a line passing through said pivot and each of said frets determining one end of at least one of said strings, and every ninth fret determining strings adapted to vibrate an octave apart, means for simultaneously moving all

frets to sub the tones of said strings, said moving means being movable about said pivot and means for moving the bridge about said pivot to change the pitch of all of said strings.

16. The stringed instrument of claim 15 including stop means for determining the distance said frets are moved whereby to sub the tones of said notes, said stop means being operatively associated with said bridge whereby changes of position of said bridge is adapted to cause changes of position of said stop means.

17. In a stringed musical instrument, a plurality of strings of unequal length and tuned in true pitch with respect to each other, movable means determining one end of said strings and being movable to vary the length of all strings in equal proportions and thereby to maintain the tone of said strings in true pitch with respect to each other, and means determining the other end of said strings.

18. The musical instrument of claim 17 in which said last named means includes a plurality of frets, said frets being selectively movable to vary the length of selected strings.

19. In a stringed musical instrument a plurality of strings, eight of said strings comprising an octave and said instrument having a plurality of octaves fret means determining one end of said strings and means determining the other end of said strings, said fret means being movable whereby to vary the length of the strings, pedal means for moving said frets a predetermined distance to sub the tones of said strings, said pedal means including eight pedals with each of said pedals being adapted to sub the tone of the same string in each octave.

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