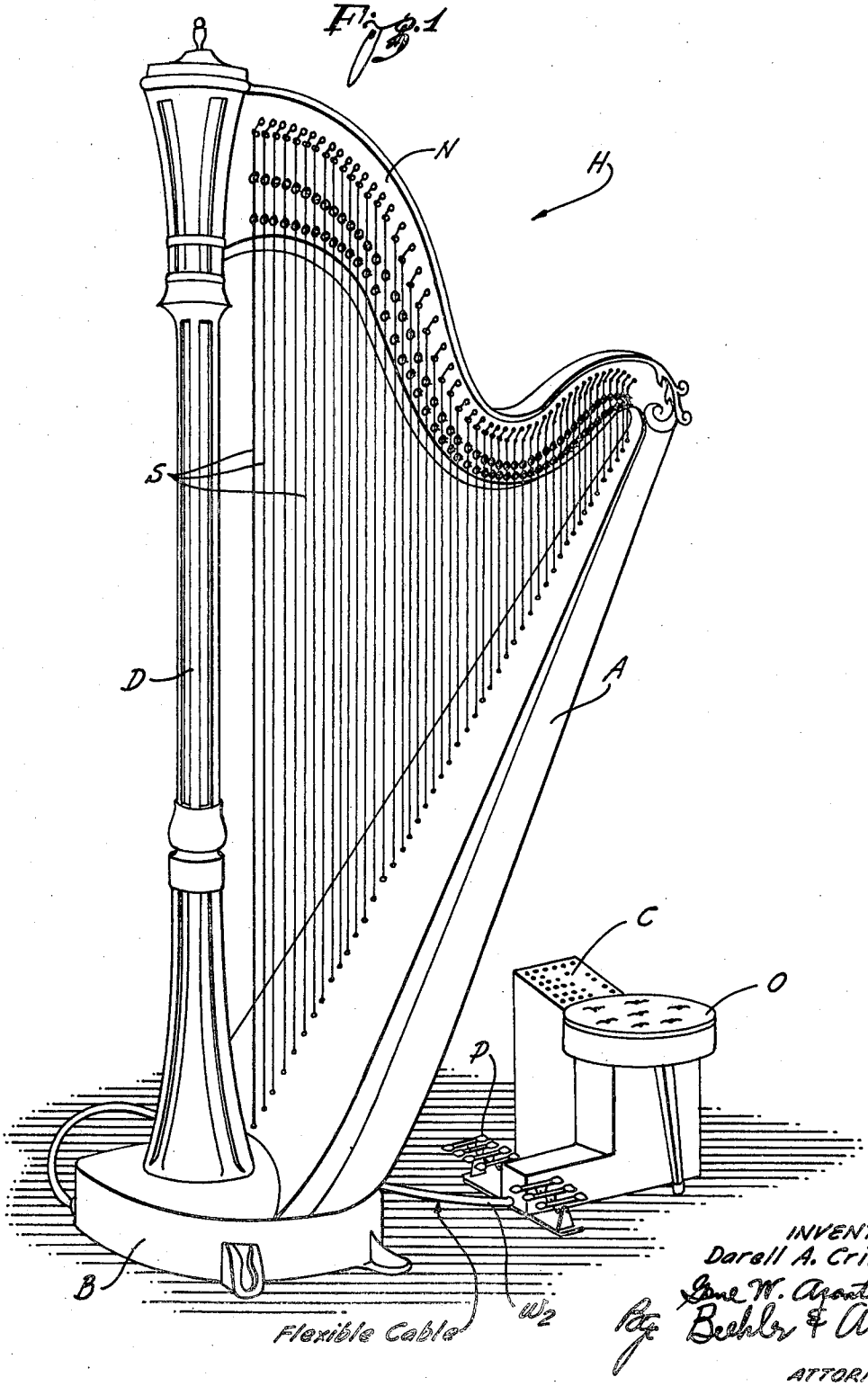
Feb. 10, 1970 D. A. CRITES 3,494,238

STRINGED INSTRUMENT WITH PRE-PROGRAMMED INSTANTANEOUS SELECTION OF MULTIPLE CHROMATIC CHANGES

Filed Feb. 8, 1968 3 Sheets-Sheet 1

Fig. 1



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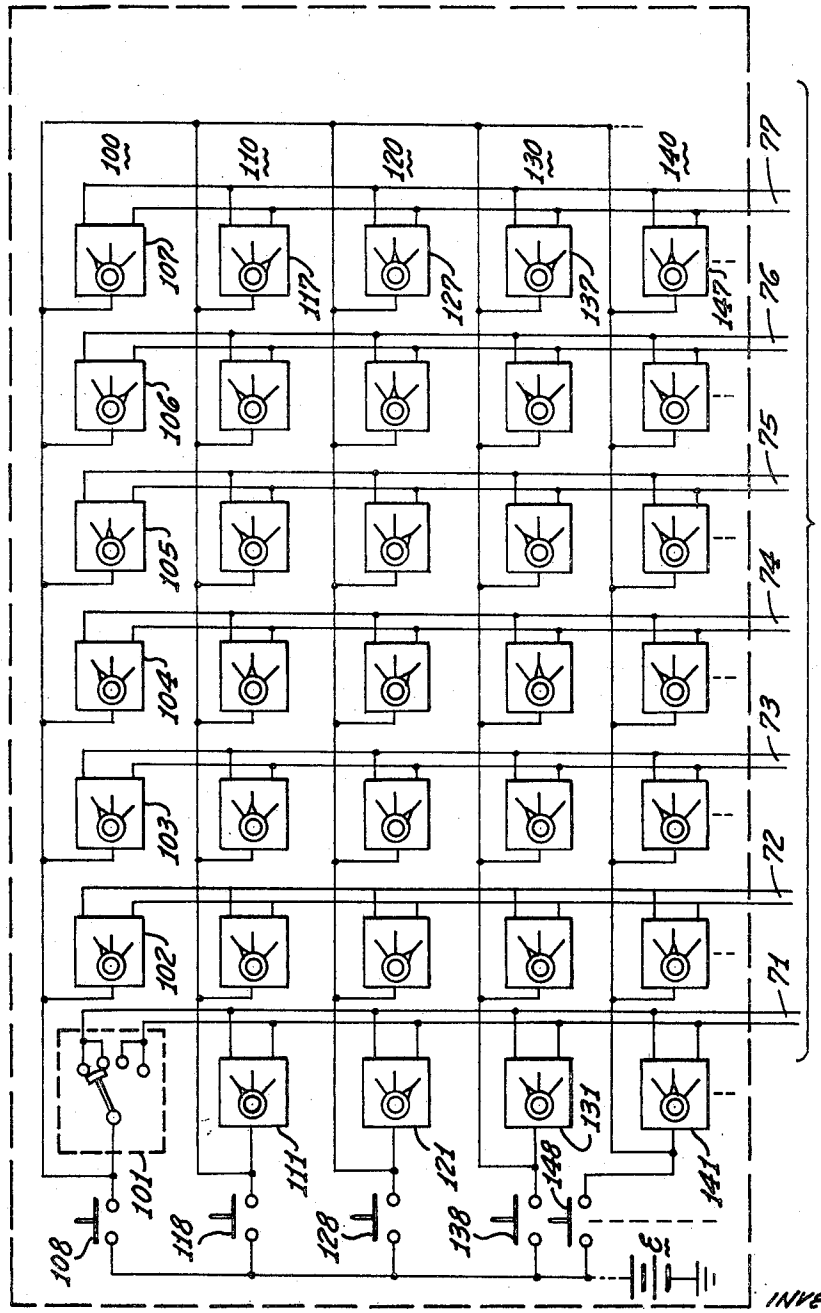


Fig. 2

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Fig. 3

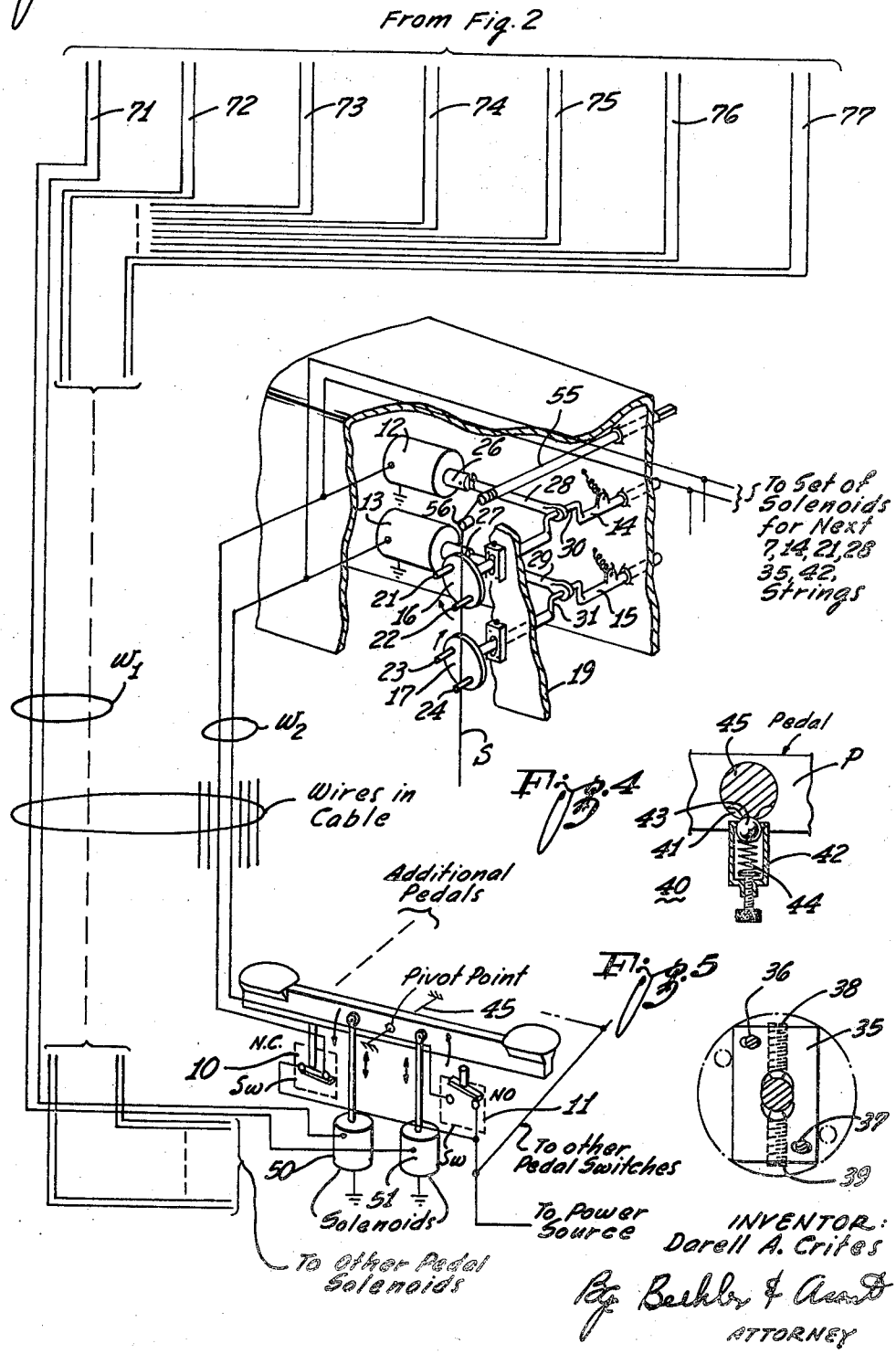


Fig. 4

Fig. 5

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STRINGED INSTRUMENT WITH PRE-PROGRAMMED INSTANTANEOUS SELECTION OF MULTIPLE CHROMATIC CHANGES

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ABSTRACT OF THE DISCLOSURE

A stringed musical instrument having foot operable pedals for controlling chromatic changes in the pitch of corresponding strings of the instrument, and which is also equipped with a manually operated control console for making instantaneous selection of pre-programmed chromatic changes in pitch of a selected group of strings.

BACKGROUND OF THE INVENTION

In certain stringed musical instruments, particularly the harp, it has heretofore been necessary to utilize foot pedals for making changes in the chromatic degree of the pitch of selected strings of the instrument. The player of the instrument has been limited in the number of strings whose pitch could be controlled at any given time, because by using this two feet it has hardly been possible to change the pitch of more than two strings at a time. Of course in the conventional harp the pitch changing mechanism is connected to all of the various octaves of the instrument, so that changing the pitch of a particular note, such as C to C sharp, will change the pitch of that note in all octaves of the instrument.

More specifically, the harp is equipped with seven strings in each octave, which correspond to the white notes on a piano. The sharps and flats, equivalent to the black notes on the piano, are achieved by raising or lowering the pitch of an adjacent string by a half tone. Sometimes the pitch of a particular string must be raised and other times it must be lowered, hence each string has three possible chromatic pitch levels.

Because of these limitations harp music has had to be specially written. But the unique musical quality of the harp, which distinguishes it from all other instruments, makes its desirable to be able to play standard compositions on the harp.

Of course it has been recognized in the past that it might be possible to equip the harp with strings of intermediate pitch, corresponding to the black notes of the piano. Unfortunately, the limitations of space and physical bulk of the instrument have not permitted this to be done. The instrument has therefore continued to be used with the inherent limitations of foot operated pedals that are capable of changing the chromatic degree of pitch of only two strings at a time.

Accordingly, the major object and purpose of the present invention is to provide a stringed musical instrument in which chromatic changes in pitch for a group of strings may be pre-programmed, and the pre-programmed changes may then be put into effect instantaneously when desired. At the present time the invention is applied to a harp, for the reasons mentioned above.

A further and additional object of the invention is to

provide a stringed musical instrument in which chromatic pitch changes that affect a number of strings of the instrument may be pre-programmed, in a programming unit which has the capacity for storing information relating to a number of such programs. It is then possible, during a musical performance, to instantaneously select a particular one of the pitch change programs that has been prepared in advance.

Another separate, distinct, and unrelated object of the invention is to provide a power actuated mechanism for changing the chromatic degree of pitch of a string of a musical instrument, thereby relieving the operator of an excessive physical workload in accomplishing a desired pitch change.

DRAWING SUMMARY

FIGURE 1 is a perspective view of a stringed musical instrument, with associated control console, which incorporates the present invention;

FIGURE 2 is a schematic wiring diagram for the control console;

FIGURE 3 is a fragmentary perspective view showing portions of the internal construction of the instrument of FIGURE 1, and also indicating electrical wiring connections in schematic form;

FIGURE 4 is a fragmentary cross-sectional view showing a detail of the pedal mechanism; and

FIGURE 5 is a fragmentary cross-sectional view of a pitch changing control shaft.

PREFERRED EMBODIMENT

The stringed musical instrument illustrated in the present drawings is designated as H, and includes a base B which rests upon the floor and from which a post D rises vertically while a sound chamber A rises at about a 45° angle from the base B. The upper extermities of post D and sound chamber A are interconnected by a neck N, and these parts together with multiple strings S form essentially a conventional harp of a type that has been known and used for about 150 years. However, as will be seen from the ensuing description, the present instrument incorporates a novel power-actuated mechanism for changing the pitch of selected indivdual strings, so that the workload upon the foot pedal is reduced to a minimum.

The principal concept of the present invention is the instrument system of a control console C, which is preferably a separate unit positioned adjacent the seat O upon which the player of the instrument sits during a musical performance. Foot pedals P are located adjacent the seat O, and in the present instrument the foot pedals are not physically or mechanically connected to the base B of the instrument but rather are simply coupled thereto through a control cable W_2 containing a plurality of electrical conductors.

The complete instrument system as shown in FIGURE 1 includes seven of the pedals P, one for each note of the scale. Each pedal has a normal position, a forward depressed position, and a rearward depressed position. In the normal position of the pedal the associated string, whose pitch is being controlled by that pedal, has its normal pitch corresponding to one-half tone higher than the full vibrating length. In the forward depressed position of the pedal the pitch of the string is lowered by one-half tone, while in the rearward depressed position the pitch of the string is raised by one-half tone.

FIGURE 3 illustrates a typical pedal mechanism, in-

cluding an electrical switch **10** which is normally closed in the normal position of the pedal, and an electrical switch **11** which is normally open in the normal position of the pedal. When the pedal is actuated to its forward depressed position the switch **10** opens, and switch **11** remains open, with the result that the pitch of the string is lowered by half a tone. When the pedal is actuated to its rearward depressed position the switch **11** closes, causing the string to assume a pitch one-half tone higher than its normal pitch, and two half-tones higher than the pitch corresponding to its full vibrating length.

Referring to FIGURE 3 where a single string S is illustrated, it will be appreciated that the lower end of the string S is fastened to the sound chamber A by conventional means, and the upper ends of the string S is fastened in conventional manner to a tuning shaft **55** and from there passes over a pin **56** which establishes the full vibrating length of the string. Spaced a short distance below the pin **56** is a cricular plate or wheel **16** having an associated pair of pins **21** and **22**, whose function when actuated is to shorten the effective vibrating length of the string so as to raise the pitch by a half tone. Positioned below the plate **16** is a similar plate **17** and pins **23** and **24**, whose function when actuated is to raise the pitch of the string two half tones above the pitch that corresponds to the full vibrating length of the string. In the normal position of pedal P the plate or wheel **16** is rotated so that the pin **21** is in an upper position and the pin **22** is in a lower position, with both of these pins tightly engaging the string S. The string then has its normal pitch. When pedal P is actuated to its forward depressed position the plate **16** rotates in such a direction as to release the pins **21** and **22** so that the string S is free to vibrate throughout its full length, extending all the way from sound chamber A to pin **56**. When pedal P is actuated to its rearward depressed position the plate **17** is rotated so that pin **23** is uppermost and pin **24** is lowermost, with both being in firm engagment with the string S, so that the pitch of the string is two half-tones higher than the pitch corresponding to its full vibrating length.

Thus the complete actuating means by which one foot pedal controls the chromatic degree of pitch of its associated string includes the switches **10** and **11**; interconnecting wires that are housed inside the cable W_2 which extends from the player's seat O to the base B of the instrument; solenoid **12** for driving a shaft **14** to rotate the plate or wheel **16**; and solenoid **13** for driving the shaft **15** to rotate the plate or wheel **17**. As shown in FIGURE 3 the electrical wires which energize solenoids **12** and **13** are also connected to similar solenoids for controlling the other strings that are one or more octaves above or below the pitch of the particular string S shown in the illustration.

The particular illustrated mechanism for controlling the pitch of string S is significant, independently of the inventive concept involving the control console C, and constitutes the subject matter of a separate patentable invention. Thus the shaft **14** is rotatably supported by the frame of the instrument, specifically an interior portion of the neck N, extends from the frame in a direction generally perpendicular to the string S, and hence parallel to the tuning shaft **55**. The solenoid or acuator **12** has a plunger **26** which extends generally perpendicular to the shaft **14**, and the plunger **26** may occupy either an energized position or a non-energized position. Shaft **14** is equipped with a crank arm **30**, and a connecting rod **28** has its ends pivotally coupled to plunger **26** and to crank arm **30**. Thus the selective energization or de-energization of the actuating solenoid **12** is effective to rotate shaft **14**, and hence the plate **16**, through a portion of a revolution, somewhat less than 90°. In lieu of crank arm **30** a rack-and-pinion may be preferrred,

FIGURE 5 of the drawings illustrates another specific feature of the actuating means, with reference to shaft **14**. The wall **19** of the neck or housing has a relatively large opening through which the shaft **14** passes, adjacent its outer end upon which the plate **16** is fastened. A rather small metal plate **35** covers this opening and has fastening screws **36, 37** which may be loosened to permit adjustment of the position of plate **35** in a horizontal direction. The plate **35** has a central opening whose horizontal width precisely accommodates shaft **14** but whose vertical width is significantly greater. Adjusting screws **38** and **39** carried in the upper and lower parts of plate **35** are effective for establishing a precisely vertically located opening for the shaft **14**. By use of this mechanism it is possible to make precise adjustments in both the horizontal position and the vertical position of shaft **14** relative to the instrument frame, and hence relative to the string S whose chromatic pitch is being controlled.

While the actuating means has been particularly described for only a single string S, it is understood that a single pedal P in conjunction with a switch **10** and a switch **11** is utilized for controlling a number of strings S, one in each octave of the instrument. Each individual string in turn has a pair of the shafts **14, 15** controlled by respective actuators **12, 13**. While the mechanism for actuator **13** and shaft **15** has not been described in detail it will be understood that it is substantially identical to the mechanism for actuator **12** and shaft **14**. The significant difference, of course, is that pin **22** on plate **16** shortens the string length by one half-tone, while pin **24** on plate **17** shortens the string length by two half-tones.

In accordance with the control concept of the present invention the instrument incorporates a position retaining means associated with each pedal P, so that the pedal will retain its existing position until positively moved to a different position. Such a position retaining mechanism **40** is illustrated in FIGURE 4. The pedal P is supported upon a horizontal shaft **45** which extends transverse to the length of the pedal. On the lower side of shaft **45** are formed three depressions **41**, one being at the exact center of the undersurface and another being forwardly located while the third is rearwardly located. A small housing **42** is attached to the bottom of the pedal, with a ball **43** being retained in the upper end of housing **42**. A spring **44** contained in housing **42** urges ball **43** upward. Ball **43** therefore assumes a locked position in one of the depressions **41**, and when the pedal is rotated either forward or backward the ball will move to a different one of the depressions.

As indicated previously the primary concept of the present invention is the provision of means for preprogrammed selection of chromatic degrees of pitch of the strings of the instrument. Toward that end there is provided the control console C which is electrically connected by means of a cable W_1 (not specifically shown, although indicated in FIGURE 3) to the pedals P. Each pedal P is equipped with a pair of solenoid devices **50, 51**, which are externally controlled from the console C for the purpose of setting the pedal to a desired position. When the solenoids are energized in a particular manner the pedal P is set to a selected position, and although the energization of the solenoids is then discontinued the pedal will remain in that position by virtue of the mechanism **40**, previously described. When both of the solenoids **50, 51** are energized the pedal P assumes its normal or horizontal position. When only the solenoid **51** is energized the pedal assumes its forwardly depressed position. If only solenoid **50** is energized the pedal assumes its rearward depressed position.

Reference is now made to FIGURE 2 of the drawings, illustrating the schematic circuit of the control console C by means of which the pedal positions may be set as desired. The control console C includes separate banks of manual selection switches identified as **100, 110, 120, 130,** and **140**, respectively. A separate control switch is associated with each bank of selection switches. Thus a control switch **108** is associated with the selection switch

bank **100**; a control switch **118** with selection switch bank **110**; and so on.

When bank **100** of selection switches is to be utilized the procedure is as follows. Switch **101** is set to a desired position for a first one of the pedals, representing a particular note in the musical scale. If switch **101** is set to the left as shown, then only solenoid **50** will be energized. If the switch is set in a central position then a complete circuit is made through both of the solenoids **50, 51**. But if the switch is set in a right hand position then only solenoid **51** will be in the circuit and solenoid **50** will be excluded. The drawing, FIGURE 2, shows the internal operating mechanism of switch **101**, and all of the other switches **102 . . . 107** and **111 . . . 117**, etc., are constructed in the same manner. Thus each of the switches **101** to **107**, inclusive, in the switch bank **100**, is set to a particular position that is desired for a corresponding one of the seven pedals. When it is desired to achieve these pedal positions the operator (or player of the instrument) momentarily closes the control switch **108**. Switch **108** is normally open, being held open by a spring or the like. The closing of switch **108** causes energy to flow from battery C to all of the selection switches **101 . . . 107** connected in parallel. The output circuits **71 . . . 77** are therefore energized accordingly, and the set of seven pedals are correspondingly positioned by the energization of their associated solenoid pairs **50, 51**.

It will be noted, however, that the control console actually has five different banks of selection switches. Before an actual musical rendition is commenced the player may wish to set all five of these selection means to different settings. Then during the musical rendition he may momentarily close whichever one of the switches **108, 118, 128, 138, 148** will provide the desired pedal combination. As soon as his hand is removed from the control switch the energization of the solenoids **50, 51** will be discontinued. The various pedals are then held in position only by the position retaining means **40**. The operator then resumes foot control of the pedal, with all seven pedals starting from the desired initial positions that he has achieved through the use of the control console.

While the presently illustrated means for controlling the strings utilizes electrical circuits and electrical solenoids, it may actually be preferred to substitute hydraulic or other types of devices for some or all of such apparatus.

The invention has been described in considerable detail in order to comply with the patent laws by providing a full public disclosure of at least one of its forms. However, such detailed description is not intended in any way to limit the broad features or principles of the invention, or the scope of patent monopoly to be granted.

Having described the invention, what is claimed as new in support of Letters Patent is:

1. In a stringed musical instrument, the combination comprising:

a string having a normal vibrating length;

a foot pedal having a normal position and at least one alternate position;

actuating means coupling said foot pedal to said string so that one position of said pedal establishes said normal string length and each other position of said pedal establishes a different length of said string corresponding to a different chromatic degree of pitch;

position retaining means associated with said pedal so that said pedal retains its existing position until positively moved to a different position; and

electromechanical means for positioning said pedal independently of its control by the foot of the operator, so that at any given time the position of said pedal and hence the chromatic degree of the pitch of said string is determined either by the foot of the operator or by said electromechanical means, whichever has exerted its control the last.

2. A stringed instrument as claimed in claim **1** wherein said foot pedal has three different positions.

3. A stringed instrument as claimed in claim **2** wherein said position retaining means includes a three-position spring-closed latch.

4. A stringed instrument as claimed in claim **1** which includes a plurality of strings each controlled by its respectively associated foot pedal.

5. A stringed instrument as claimed in claim **4** which further includes a selection panel for selecting the chromatic degree of pitch of all of said strings, and control means for concurrently actuating all of said electromechanical means to thereby position all of said pedals simultaneously.

6. In a stringed musical instrument, the combination comprising:

a plurality of strings each having a normal vibrating length;

a plurality of foot pedals each foot operable among a plurality of discrete predetermined positions for controlling the vibrating length and hence the chromatic degree of pitch of a respective one of said strings, each said foot pedal having associated actuating means which drivingly couples it to the respective string;

position retaining means associated with each of said pedals so that said pedal retains its existing position until positively moved to a different position;

a control console including manually operated selection means for selecting a set of desired initial positions of said foot pedals;

a plurality of position setting means controlled by said selection means for mechanically setting the positions of respective ones of said foot pedals;

and control means for energizing all of said position setting means concurrently;

whereby the position of each pedal and hence the chromatic degree of pitch of the associated string is determined either by said selection means or by the foot of the operator, whichever has last exerted its control.

7. A stringed musical instrument as claimed in claim **6** wherein said control console includes a plurality of said manually operated selection means, and which also includes a plurality of said control means each of which is adapted for energizing said position setting means under control of a different one of said selection means.

8. A stringed musical instrument comprising:

a plurality of strings arranged to produce the notes of a scale through a range of at least two octaves;

a control console including a set of control devices which respectively correspond to the scalar notes within an octave, each of said control devices being manually settable to a selected one of different positions representing different chromatic pitch level of the corresponding note of the octave;

a plurality of control means for controlling the chromatic pitch of said plurality of strings, each of said control means being responsive to a corresponding one of said control devices for controlling the pitch of the corresponding note strings in all the octaves of the instrument concurrently; and

manually controlled actuating means for actuating all of said control means concurrently in response to the settings of their respectively associated control devices.

9. A stringed instrument as claimed in claim **8** wherein said control console includes at least two separate sets of control devices, each set of control devices being independently sufficient for controlling said control means, said actuating means being operable for actuating said control means in accordance with the setting stored in a selected one of said sets of control devices.

10. An instrument as claimed in claim **8** which further

includes means for operating said control means independently of said control console.

11. An instrument as claimed in claim **10** wherein each of said control means includes a foot pedal having position retaining means associated therewith so that said foot pedal retains its existing position until it is positively moved to a different position.

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