Oct. 21, 1952 F. MACHÁLEK 2,614,449

STRING INSTRUMENT

Filed April 12, 1949

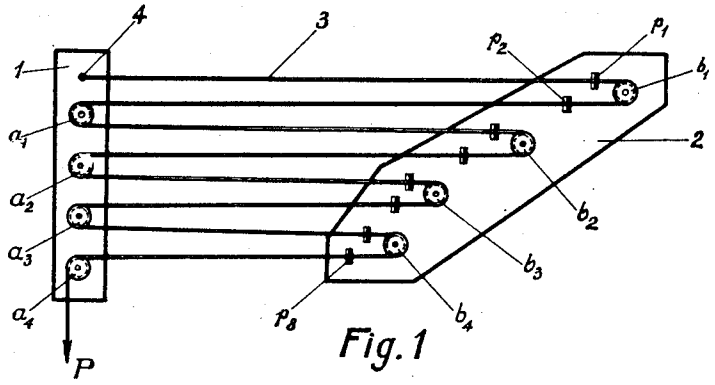


Fig. 1

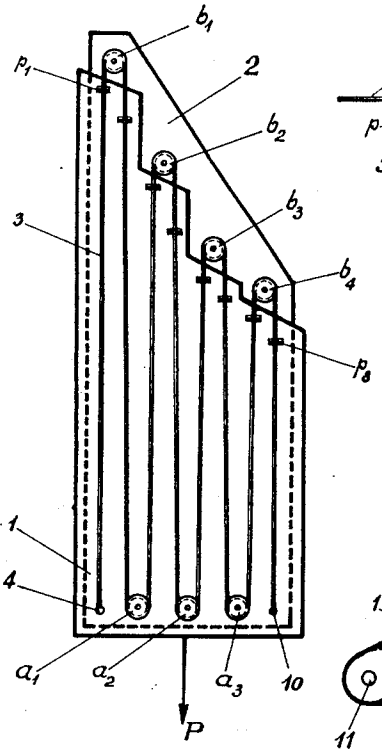


Fig. 3

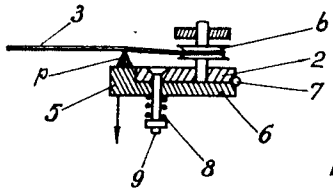
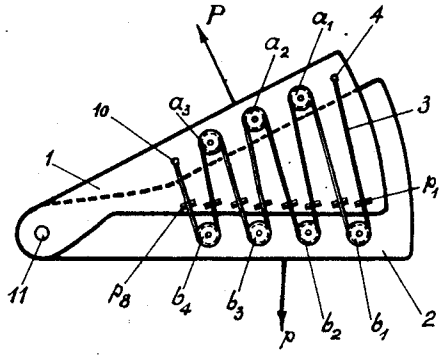


Fig. 2

Fig. 4



Inventor:
Ferdinand Machalek
By: Mudael & Stern

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STRING INSTRUMENT

Ferdinand Machálek, Blatno, Czechoslovakia

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Stringed musical instruments are generally provided with a set of individual strings, which are tuned to a certain frequency and actuated in any known way either to produce sounds which are directly audible or to vibrate mechanically in a frequency range corresponding to inaudible sounds, in which case such vibrations are picked up electrically, electrostatically or electromagnetically and reproduced by means of an amplifier supplying a loud speaker.

Instruments of such a kind must be rather frequently tuned to keep their oscillating frequencies on the desired value especially if the strings are of different material and thickness and if they are subject to changes of temperature or moisture content in the surrounding air.

It is an object of the invention to provide such an instrument, where the tuning of the strings may be either completely eliminated or at least reduced to a measure, where the whole tuning may be carried out quickly and more accurately.

In accordance with known physical laws, the oscillating frequency of a string is directly proportional to the square root of its tension and indirectly proportional to the length of the string and to the square root of its mass. If a single string is used, the different parts of which are used for generating different frequencies, and an equal tension of the different string parts is kept, the mass remains equal and the resulting frequency is only indirectly proportional to the length of the respective string part.

The invention is by way of example shown diagrammatically in the accompanying drawing, showing in Fig. 1 one suitable arrangement, in Fig. 2 a detail of an arrangement of the bridge, in Figs. 3 and 4 other embodiments of the invention.

In the arrangement shown in Fig. 1 a string **3** is stretched between two frame parts **1**, **2** over two sets of rollers a_1, a_2, a_3, a_4 and b_1, b_2, b_3, b_4. The string **3** is fixed at **4** on the frame **1** and is guided consecutively over the rollers b_1, a_1, b_2 and so on until it is fixed either below the roller a_4 upon a tuning key, or to a weight or any other force acting upon the end of the string. The distances between the two sets of rollers are such, that the lengths of the respective string parts correspond to the required pitch.

If the force acting thus upon the end of the string is P, the force stretching the string part between the rollers a_4 and b_4 is P minus the frictional resistance of the roller a_4, similarly the string part between the rollers b_4 and a_3 is stretched by a force additionally reduced by the friction of roller b_4, and so on.

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An equalization of the stretching forces may be obtained by sounding the strings, wherein the oscillations produced practically perfectly equalize the tension of all the string parts.

If one frame part is used, where the line connecting the centres of the respective roller set is perpendicular to the string parts, two string parts are always of the same length. If it is desired that every string part should cover a different tone, it is necessary to provide bridges p_1, p_2 . . . p_8 near one of the roller sets. As the angle, by which the string passes over the bridge, does not differ much from 180°, the pressure of the string upon the bridge is small, so that the bridges do not substantially increase the friction.

To make the equalization of the tension of different string parts easier, it is possible to bring said bridges out of contact with the string portions just for the time necessary for the equalization of the tension which may be carried out, for instance, by sounding the strings. An example of such an arrangement is shown diagrammatically in Fig. 2.

The frame part **2** carries the roller b, over which the string **3** is stretched in the manner as described with reference to Fig. 1. The bridge p is arranged on ledge **5** held by a bracket **6**, fixed by means of hinges **7** to the frame **2**. A helical spring **8** acting upon this bracket **6** and guided by the bolt **7**, provided with a nut, is pressing this bracket against the frame **2** and brings simultaneously the bridge p in engagement with the string **3**. By overcoming the pressure of the spring **8** by acting upon the bracket **6** in the direction of the arrow, the bridge p may be removed from engagement with the string. After equalization of the tension of the different string parts, the bridges p may be again brought into engagement with the string **3**.

Instead of the string **3** being fixed at one end and stretched by some force at the other end, it is possible to fix both ends of the string on one frame part, carrying one set of rollers. Fig. 3 shows such an arrangement. The frame parts **1** and **2** each carry one of the roller sets a and b respectively. The ends of the string **3** are fixed at the points **4** and **10** on the frame part **1**. The bridges p_1, p_2 . . . p_8 are arranged on extensions of the frame part **1**, which is slidable against the frame part **2** in the direction of the pull of the strings. The frame part **2** is fixed while on the frame part **1** a force P acts in the downward direction to stretch the respective string parts. In some cases this force P may be represented by the weight of the frame part **1** with its accessories. Thus the same effect may be obtained as

in Fig. 1, but the effect of the frictional resistance of the rollers is minimized, and both ends of the string are fixed.

Instead of using two frame parts one of which is slidable with respect to the other in the direction of the pull of the strings, both frame parts may be arranged pivotally with respect to each other and held apart by a stable force. Fig. 4 shows such an arrangement. The frame parts 1 and 2 carry again each one roller set *a* and *b* respectively. Both frame parts 1 and 2 are pivotally connected and may be turned around the pivot 11. The ends of the string 3 are fixed in the places 4 and 10 on the frame part 1 and guided consecutively over the roller sets *a* and *b*. Bridges p_1 . . . p_8 are arranged on an extension of the frame part 1 and a force P acts in the direction of the indicated arrows to hold both frame parts apart. In other respects this arrangement acts in the same way as the arrangement described in the foregoing. It is to be noted that while in Figure 3 one frame part is slidably arranged with respect to the other, whereas in Figure 4 such frame parts are pivotally connected to each other, the common character of both these frames resides in that the said parts are collapsably arranged with respect to each other.

The bridges p_1, p_2 . . . shown in Figs. 1, 3 and 4, may be replaced by rollers, thus reducing still more their effect upon the tension of the string and providing for more easily equalizing the tension.

When using a string stretched according to any of the methods described, it is possible to change the pitch of all strings simultaneously by increasing or decreasing their tension, whereby the ratio of their lengths remains constant. The sounding of the strings may be done in any known way, for example, by a keyboard.

It is obvious, that the arrangement as described may be changed in many ways within the scope of the invention. It is, for instance, possible to use no bridges at all and arrange the rollers at such a distance, that the distances between the rollers determine the length of the individual string parts only. If each string part has to be used for a different frequency, the connecting lines of the centers of the rollers must not be at a right angle to the respective string parts. Instead of individual bridges a common bridge may be used for all parts of a string. Similarly there may be the possibility of adjusting the active length of each string part by adjusting the position of the bridge.

All of the above discussed embodiments are considered to be understood by those skilled in the art to which the present invention is a contribution.

Instruments of this kind show a high degree of stability, the different string parts are influenced by outside conditions in the same way, so that they react to those influences equally and said string parts do not become mutually out of tune by any changes of moisture of the air, or by differences of temperature. The tuning if required at all is done quickly and effectively.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare, that what I claim is:

1. A string instrument, comprising in combination, a frame including two parts pivotally connected to each other; two sets of rollers arranged on said parts, respectively, opposite to each other, the distances between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression; a string having the ends thereof secured to one of said parts and forming a zig-zag line engaging alternately a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having increasing lengths; and means for exerting a force on said parts of said frame urging said parts asunder whereby the portions of said string are tensioned so as to produce frequencies in the ratio of the lengths of the portions of said string.

2. A frame for use in a stringed musical instrument, comprising two distinct parts adjustably arranged with respect to each other, two sets of rollers rotatably arranged on said parts, respectively, opposite to each other, the distances between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression, a vibratable string having both its ends secured to one of said parts and forming a zig-zag line engaging alternately a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having lengths corresponding to their frequencies of vibration and means for simultaneously stretching all of said portions so as to produce frequencies in the ratio of the lengths of said portions.

3. A frame for use in a stringed musical instrument, comprising two distinct parts adjustably arranged with respect to each other, one of said parts carrying a pin at one of its ends and a tuning key at its other end, two sets of rollers rotatably arranged on said parts, respectively, opposite to each other, the distances between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression, a vibratable string having its ends fixed on said pin and on said key, respectively, and forming a zig-zag line engaging alternately a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having lengths corresponding to their frequencies of vibration.

4. A frame for use in a stringed musical instrument, comprising two distinct parts collapsably arranged with respect to each other, two sets of rollers rotatably arranged on said parts, respectively, opposite to each other, the distances between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression, a vibratable string having both its ends secured to one of said parts and forming a zig-zag line engaging alternately a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having lengths corresponding to their frequencies of vibration and means for exerting a force on said parts of said frame urging said parts asunder whereby the portions of said string are tensioned so as to produce frequencies in the ratio of the lengths of the portions of said string.

5. A frame for use in a stringed musical instrument, comprising two distinct parts arranged for translatory motion with respect to each other, two sets of rollers arranged on said parts, respectively, opposite to each other, the distance between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression; a string having the ends thereof secured to one of said parts and forming a zig-zag line engaging alternately

a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having increasing lengths, and means for exerting a force on said parts of said frame urging said parts asunder whereby the portions of said string are tensioned so as to produce frequencies in the ratio of the lengths of the portions of said string.

6. A frame for use in a stringed musical instrument comprising two distinct parts collapsably arranged with respect to each other, two sets of rollers rotatably arranged on said parts, respectively, opposite to each other, the distances between a roller of one of said sets and the opposite roller of the other one of said sets forming an increasing progression, a vibratable string having both its ends secured to one of said parts and forming a zig-zag line engaging alternately a roller of one of said sets and a roller of the other one of said sets so as to be subdivided into succeeding portions having lengths corresponding to their frequencies of vibration, bridges arranged near one of said sets of rollers and adapted to limit the lengths of the portions of said string, respectively, a member supporting said bridges and hinged to said part carrying said set of rollers near which said bridges are arranged, resilient means pressing said member against said part and means for exerting a force on said parts of said frame urging said parts asunder whereby the portions of said string are tensioned so as to produce frequencies in the ratio of the lengths of the portions of said strings.

FERDINAND MACHÁLEK.

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