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STRING FOR STRINGED INSTRUMENTS AND METHOD OF MAKING SAME

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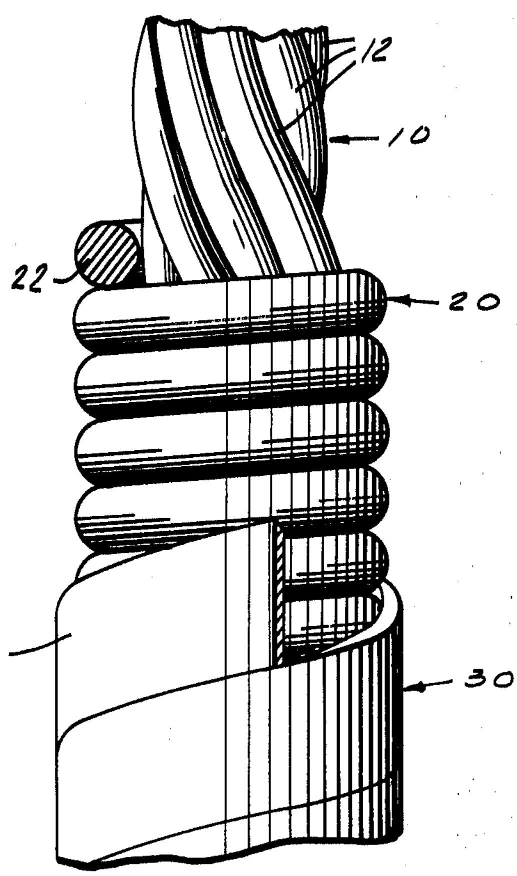
Fig. 1



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STRING FOR STRINGED INSTRUMENTS AND METHOD OF MAKING SAME

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ABSTRACT OF THE DISCLOSURE

A string for stringed instruments having equal torsion rigidity in both directions of rotation includes an elastically resilient coarse-pitch tension bearing rope-shaped core composed of synthetic continuous filaments of plastic material rope core which is provided with at least one less pitched covering layer composed of round wires or flat bands. The rope consists of threads with a breaking elongation in the range of 9 to 15 percent, a tensile strength in the range of 80 to 110 kg./mm.^{2}, and a modulus of elasticity in the range of 1150 to 1350 kg./mm.^{2}. The rope is covered with each covering layer while it is stretched under a tension corresponding to at least its expected subsequent tension on the instrument.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a string for stringed musical instruments having equal torsion rigidity in both directions of rotation and comprising an elastically resilient, high pitch, and rope type twisted core composed of fully synthetic filaments, which is provided with at least one covering made up of round wires or flat bands and having a lower pitch.

Prior art

Gut strings have been employed for stringed instruments since time immemorial. However, despite their pleasant tone quality, they have only a limited sound volume producing ability. Moreover, because they are hygroscopic they very easily get out of tune. The higher pitched thin strings on the other hand break easily.

Attempts have been made to eliminate these disadvantages by covering the gut core with one or more covering layers of textile or metallic material. Thus, to overcome the problems caused by the hygroscopicity, strings have been developed using a steel wire as the tension bearing member. The steel wire may be blank or be provided with one or more metallic covering layers. While steel strings do not creep and therefore need less tuning, they do, however, have the drawback that they are less elastic than gut strings because they have a high elasticity module, and thus are more inflexible and feel harder under the finger. Often, the volume of sound from steel wire strings is unsatisfactory. To obviate these drawbacks of steel strings, it has already been proposed to use a rope of endless or continuous thin steel wires or strands respectively as the tension carrying member instead of a single steel wire. Steel wire ropes have, for many years, been covered with one or more covering wire means layers and made with open or closed surfaces. When the rope formed a hollow tube this was filled with a soft insert. The soft filling may have been copper, aluminum or nylon and comprised a plurality of strands nested together. The filling, having no tension imposed thereon, serves only to fill out the central cavity of the steel rope. These steel rope strings may be sufficiently elastic, but have the tendency to produce "discontinuous" sounds.

Such rope strings are more mobile and softer during the play, owing to their increased elasticity, but have the drawback that the upper covering layers loosen in use and, particularly when they consist of metal, will lead to harmonic distortion and, thus to increased generation of discontinuous sounds. The elasticity of these rope strings is also limited and does not attain the degree of elasticity of gut strings, so that altogether they are unsatisfactory for use in stringed instruments as far as the sound is concerned, and are therefore frequently unacceptable to great violinists. Attempts have been made to prevent the coverings from loosening by closing the gaps and interspaces in a core of natural or synthetic filaments which is stranded with a number of metal stranded wires extending in helical lines by means of an elastic interlayer made up of synthetic resin on the basis of polyamides, and using this layer simultaneously as an elastic support for one or more coverings of round wires or flat bands. The strings produce a somewhat hollow tone, but the hardness of these steel strings is an inherent drawback and not acceptable.

Further efforts have finally been made to replace gut strings by nylon filaments or wire strings, whereby the nylon wire is covered or used without covering, however, these nylon strings have the same inherent drawback of creeping as gut strings, with the attendant necessity of frequent tuning. This drawback is not completely eliminated in a string of previous construction which consists of a core composed of a number of parallel covered twisted nylon filaments corresponding to the desired pitch, which has a wire wrapping of nylon, silver, copper, aluminum, silk and the like.

SUMMARY OF THE INVENTION

To overcome the many disadvantages of the prior art structure, I have provided a string for musical stringed instruments whose musical properties are at least as good as those of gut strings, and which combines these musical properties with the advantageous property found in steel strings, namely infrequent tuning.

I have discovered that while in a string for stringed musical instruments there is the problem that the string must have the same torsion rigidity in both directions of rotation because the response through the bow, which must be played over the string in both directions, must be equal, there is also the problem to properly select and adjust the kind and tension of the core, the physical properties of the core material and the pitch of the core and the layers. These problems are solved according to the principles of the present invention by the provision of a core consisting of a twisted or stranded high pitched bundle of fully synthetic endless filaments having a breaking elongation generally in the range of 9 to 15%, or more specifically 9 to 12%, and a tensile strength of about 80 to 110 kgs./mm.^{2} which is covered while under a tension corresponding to at least the subsequent tension on the instrument. For best results the elasticity module of the endless core filaments must be on the order of 1150 to 1350 kgs./mm.^{2}. The covering is generally laid crosswise to the core, such that in the last analysis the torsion rigidity of the strings is equal in both directions. This equality of torsion rigidity is readily achieved by syntonizing the length of twist and the angle of twist of the core to those the covering.

Holding the breaking elongation property of the endless core filaments to 15% or less avoids the danger that the coverings will loosen from the core as does covering under the high tension.

It is also important to provide strings of high tensile strength so they may be highly tuned without breaking. Thus, for example, the core of the E string of a violin according to my invention advantageously has a total denier of 1435 and consists of 7 individual endless filament of 205 denier each. Fully synthetic endless cores consisting of polyamide filaments, particularly nylon 6, 10 and polyester filaments also have been very successfully used. In addition polyurethene filaments and polyethylene filaments may be employed.

Covering strands may be round wires with dimensions between 0.03 and 0.35 mm. for violin to contrabass respectively, and/or flat bands of aluminum alloys, e.g. AlMg 5, chromium nickel steel, pure nickel, pure silver, aluminum silver alloys, copper and other conventional covering materials. Metal wrappings are preferred to woven fabrics in most circumstances.

The method of porducing a string of the present invention comprises covering a high pitched, rope-shaped core with at least one round wire or flat band layer under a specific tension such that the torsion rigidity of the string is equal in both directions of rotation. This tension will correspond in magnitude to the expected subsequent tension of the string on the instrument. It is also possible according to a further embodiment of my invention to substitute for the core rope of synthetic endless filaments which will have no torsional movement, a bundle made up of fully synthetic endless filaments having a breaking elongation of approximately 9 to 15%, which is twisted to provide a high pitch in one direction, which is then covered in one layer in the opposite direction under a tension that corresponds to at least the expected subsequent tension of the string in place on the instrument. In this manner the method of my invention compensates for the free torsional movement of the twisted bundle of filaments and imparts to the finished string the same torsion rigidity in both directions.

According to a further embodiment of my invention a second covering layer is wound about the first covering layer in a direction crosswise to the first covering layer to thereby secure the first covering layer firmly in position thus assuing the same torsion rigidity of the string in both directions.

BRIEF DESCRIPTION OF THE DRAWING

Other objects, features and advantages of the invention will be readily apparent from the following description of certain preferred embodiments thereof, taken in conjunction with the accompanying drawing, although variations and modifications may be effected without departing from the spirit and scope of the novel concepts of the disclosure, and in which:

FIG. 1 is a schematic representation of a string according to my invention wherein the string has both a first and second covering layer.

It will be understood that this one figure effectively illustrates both a one layer and two layer embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

There is shown in FIG. 1 a string for a musical instrument according to my invention comprising a core **10**, a first covering layer **20** and a second covering layer **30**. The core **10** consists of a twisted or stranded high pitch twist bundle of fully synthetic endless filaments **12** having a breaking elongation generally in the range of 9 to 15%, and a tensile strength of about 80 to 110 kgs./mm.^{2}. In practice I have found it very advantageous to provide core filaments **12** having a module of elasticity of 1150 to 1350 kgs./mm.^{2}. It is important that the breaking elongation of the endless core filaments **12** be 15% or less so that the danger of the covering **20** and **30** coming loose from the core will be avoided. Many fully synthetic endless filaments of woven fabric have an excessive breaking elongation greater than 18% and thus are unacceptable. Others, such as some of the technically fully synthetic endless filaments have breaking elongations in the range of only 4 to 7% and these also will not perform satisfactorily.

To allow high tuning of the strings without breakage it is important that the filament **12** have a high tensile strength. Thus, where the core **10** is for an E string of a violin I have found it advantageous to provide a total denier of 1435 for the core and in such case have found that 7 individual endless filaments **12** each having a denier of 205 provide excellent results. The fully synthetic endless cores **10** may consist of filaments of polyamide material particularly nylon 6, 10 or a polyester filament. Other examples of synthetic materials for the core filaments **12** include polyurethane and polyethylene.

The filaments **12** of the core **10** are twisted together in one direction to form a very tight core. If a bundle of nylon filaments **12** are used as a starting point as for example in the production of a violin string, the core **10** has about 30 to 50 complete twists per meter of length.

The covering layers **20** and **30** are generally laid crosswise to the core so that the torsion rigidity of the strings is equal in both directions of rotation so that the response through the bow will be equal as it is played over the string in both directions. This equality of torsion rigidity is readily achieved by syntonizing the length of twist and the angle of twist of the core to the length of twist and the angle of twist of the coverings **20** and/or **30**. As previously explained, maintaining the breaking elongation factor of the core filaments to 15% or less avoids any danger of the coverings loosening from the core.

As shown in FIG. 1 the covering materials may include either round wire strands such as shown at **22** or flat bands such as indicated at **32**. In practice I have found that round wires with dimensions between 0.03 and 0.35 millimeter for a violin to contrabass respectively produce excellent results. These round wires **22** may be of conventional material. For the flat band **32** I have found that aluminum alloys, e.g. AlMg 5, chromium nickel steel, pure nickel, pure silver, aluminum-silver alloys, copper, and other conventional metal covering materials perform very well. Although it may be possible in some circumstances to use nonmetallic conventional covering and materials I prefer the metal wrappings to woven fabrics. To wrap the core **10** one or more parallel covering wires are employed depending upon the desired final torsion strength. If the wrapping of the core **10** is effected with only one wire, the torsion strength of the core rope is altered then if a plurality of parallel wires or tapes are used. In accordance with an embodiment of my invention a finished thin E string of a violin has a diameter of about 0.54 mm., while the diameter of a bass string may be as large as 3.9 mm. Regardless of the size however, each string according to my invention produces a pure, pleasant soft tone of great sonority. Moreover, the string responds very well and does not resonate when the tones are changed rapidly. In all, the string of my invention encompasses all the advantages of the elastic playability of gut strings with none of the aforementioned disadvantages.

The core filaments being of various size and twisted to varying degrees depending upon their use, may have residual stresses that produce a certain amount of unbalanced torsional moment which must be compensated in the string so that the finished string has the same torsional rigidity in both directions of rotation. According to my invention this unbalanced torsional moment may be compensated for in a number of ways by the component elements of my invention depending upon the core size, pitch and filament size and material. Thus, in some situations in thin strings the moment may be offset by wrapping the first covering layer in a direction opposite or crosswise of the direction of the core filaments. An additional second layer may also be provided in the same direction as the first layer. In other situations the first covering layer of fine round wire may be wound in the same direction as the core but of a higher pitch and the second covering layer of flat bands may be then wound in the opposite or crosswise direction.

Where the core has no unbalanced torsional moment the covering or combinations of covering must likewise have no unbalanced torsional moment.

The use of a nylon rope core gives the string of my invention the strength and durability of steel strings as well as their purity and great clarity of sound. A substantial advantage over all steel strings is the fact that the strain or tension of the instrument is substantially lower and not greater than when gut strings are employed. More exactly, the tension caused by the pressure on the cover and the entire body of the instrument is such that in a bass string for example it amounts to only 60 to 70% of the tension caused by steel rope strings. It is therefore apparent that the disadvantages of the prior art as for example the hygroscopicity of gut strings and the easy breakability of steel strings are clearly avoided by the strings of my invention.

The general steps in the method of producing the string according to my invention comprises twisting a bundle of parallel pre-stressed filaments into a coarse pitch rope-shaped core **10**, applying a substantial tension in the twisted core and wrapping a covering about the core with at least one round wire or flat band. The tension of the covering and core must be such that the torsion rigidity of the string is equal in both directions of rotation. The magnitude of this tension according to my method corresponds to at least the expected subsequent tension on the string when it is placed on the instrument. It is to be understood that the core comprises fully synthetic endless filaments having a breaking elongation in the range of 9 to 15%, a tensile strength of about 80–110 kgs./mm.^{2} and a module of elasticity of about 1150 to 1350 kgs./mm^2.

As previously set forth it is important that the torsional rigidity of the string be equal in both directions so that the qualities will be the same regardless of which direction the bow is drawn and thus the first covering layer may be wound on the core in either the same direction, but with a higher pitch or in an opposite direction. Moreover, to assure the torsional rigidity in both directions it is within the contemplation of my invention to provide a second covering layer **30** on the first covering layer **20** with a higher pitch and either in the same or crosswise direction. Tension on the various elements will of course, be maintained at a magnitude at least equal to the expected strain on the string when in operative position on the instrument.

In the production of an A string for a violin for example, I impart approximately 30 to 50 twists per meter on the bundle of filaments **10** and then tension this twisted core with 3.6 to 5 kilograms before covering the core with one or more of the lower pitched layers.

Although minor modifications might be suggested by

those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A string for a stringed instrument having equal torsion rigidity in both directions of rotation comprising a resilient, tension bearing core formed of a plurality of steeply wound twisted fully synthetic continuous threads and at least one less pitched covering layer of wire means thereabout, said core consisting of fully synthetic endless threads with a breaking elongation in the range of 9 to 15 percent and a tensile strength in the range of 80 to 110 kg./mm.^{2}, wherein said core bears a substantial portion of the tension on said string when placed on the instrument.

2. A string for a string instrument according to claim **1** wherein said covering wire means is a round wire.

3. A string for a string instrument according to claim **1** wherein said covering wire means is a flat band.

4. A string for a string instrument according to claim **1** wherein said fully synthetic continuous threads of said core have an elasticity modulus in the range of 1150 through 1350 kg./mm.^{2}.

5. A string for a string instrument according to claim **1** wherein said fully synthetic continuous threads are made of a polyamide material.

6. A string for a string instrument according to claim **5** wherein said polyamide material is nylon 6, 10.

7. A string for a string instrument according to claim **1** wherein said core consists of polyester threads.

8. A string for a string instrument according to claim **1** wherein said core consists of polyurethane threads.

9. A string for a string instrument according to claim **1** wherein said core consists of polyethylene threads.

10. A string for a string instrument according to claim **2** wherein said round wire is a diameter in the range of 0.03 to 0.35 mm. and is of a metallic material.

11. A string for a stringed instrument according to claim **1** wherein each of said covering layers is applied to said core when said core is tensioned at least equal to the expected subsequent tension on the string when it is in place on the stringed instrument.

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