June 14, 1955 E. V. SUNDT 2,710,557

MUSICAL INSTRUMENT STRINGS

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Fig. 1

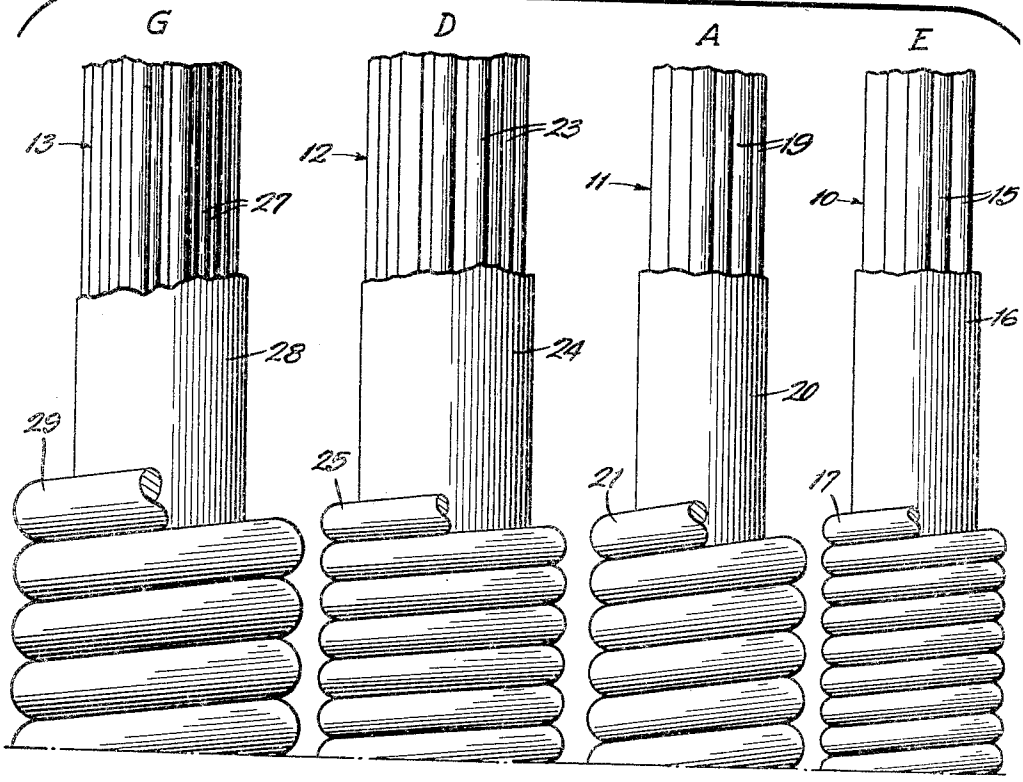


Fig. 2

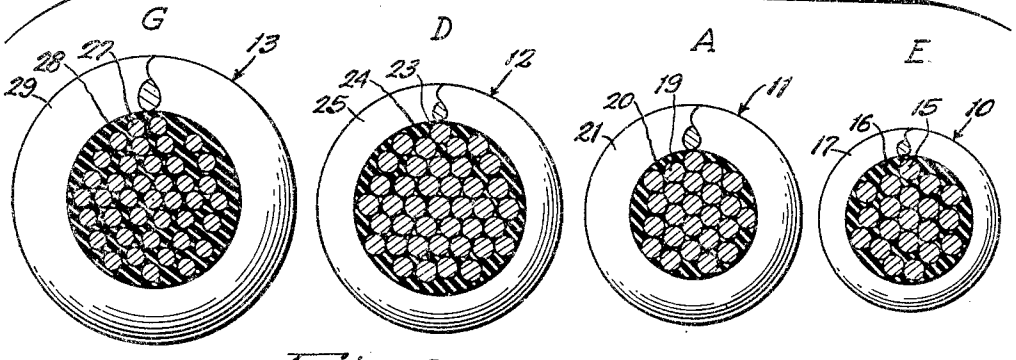
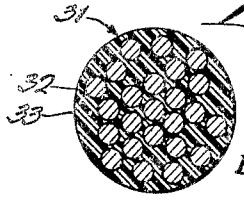


Fig. 3



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MUSICAL INSTRUMENT STRINGS

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This invention relates generally to strings for stringed musical instruments and more particularly to strings for violins.

While considerable technology has been devoted to the construction of violins and other stringed instruments for improving the same, very little, if any, has been successfully accomplished toward improving the strings thereof. After all of these years of history gut strings are still widely used on violins along with a steel E string. All attempts to provide improved violin strings have been unsuccessful as is evidenced by the continued use of conventional gut strings.

Conventional gut strings are not wholly satisfactory for they are subject to rapid deterioration and break easily, they stretch readily causing them to lose their pitch, they are not properly weighted and are tensioned differently which greatly effects the tonal quality of the violin and audibly indicates movement from one string to another during playing of the violin.

Various types of violin strings have been proposed in the past and, while they have proven stronger than the gut strings, they have not improved upon the tonal qualities. In fact, they have been a step backward in this respect. Such strings have uniformly been more rigid, vibrating as a bar rather than a string, and there have been no successful steps in properly correlating the strings.

The principal object of this invention is to provide an improved set of strings for a stringed musical instrument such as a violin wherein the strings of the set are so constructed and related to each other as to provide maximum strength and tonal qualities. In this respect each violin string is made of a plurality of wires of small diameter which are impregnated with and bonded together by an elastomer. As a result, each string has maximum strength and maximum flexibility so as to vibrate as nearly as possible as a string and to be subjected to minimum damping when fingered. In relating the strings of the set each string is preferably made of substantially the same diameter, the differences in diameter being relatively small, in order to provide for ease in fingering and uniform tonal quality between strings. The strings of the set are preferably weighted in substantially a geometrical progression in order that the strings may be substantially equally tensioned to bring them to pitch. This further equalizes the tonal quality providing each string with substantially the same degree of harmonic contents. The graduated weighting of the strings may be accomplished by winding the strings with wires of different weight.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference to the specification, claims and drawing, in which:

Fig. 1 is a plan view of the related E, A, D and G violin strings of this invention with portions thereof broken away for purposes of illustration, and

Fig. 2 is a transverse sectional view through tthe violin strings of Fig. 1 and

Fig. 3 is a transverse sectional view of a modified form of the E string.

While the principles of this invention are applicable to strings of various types of stringed musical instruments they are disclosed in this application with particular reference to strings for violins. The E, A, D and G violin strings are generally designated in Figs. 1 and 2 at **10**, **11**, **12** and **13** respectively.

The E string **10** preferably includes a plurality of closely associated wires **15** of small diameter, as for example, 20 strands of approximately .002 in. diameter high carbon steel wires. These closely associated wires of small diameter are impregnated with and bonded together by an elastomer **16** having the properties of natural, reclaimed, vulcanized or synthetic rubber. The elastomer **16** may consist of rubber or rubber substitutes, such as, those produced by polymerisation of butadiene alone or with styrene, interaction between sodium polysulfides and dihalides, polymerisation of chloroprene, polymerisation and plasticisation of vinyl chloride, polymerisation of isobutylene. The impregnated core is preferably wound with a light weight metal wire **17** having a density between 100 and 200 lbs. per cubic ft., as for example, magnesium or aluminum wire of approximately .002 in. in diameter. The resulting E string has an overall diameter of approximately .016 in.

The A string **11** also includes a plurality of closely associated wires **19** of small diameter which are impregnated with and bonded together by an elastomer **20**. The closely associated wires may include 24 strands of approximately .002 in. high carbon steel and the elastomer may be of the same type as the elastomer **16** for the E string **10**. The resulting core is tightly wound with a heavier wire **21** having a density between 400 and 700 lbs. per cubic ft. A large variety of wires for this purpose may be utilized including, for example, antimony, copper, cobalt, manganese, molybdenum, nickel, silver, zinc, bismuth, cadmium, chromium, tin, vanadium or the like. Extremely suitable results have been obtained by winding the core with an approximately .004 in. diameter copper or Phosphor bronze wire. The resulting A string has an outside diameter of approximately .019 inch.

The D string **12** also includes a plurality of closely associated wires **23** of small diameter impregnated with and bonded together by an elastomer **24**. Here 40 strands of approximately .002 in. high carbon steel wires may be impregnated with and bonded together by an elastomer similar to that used in the E string **10**. The resulting core may be tightly wound with a still heavier wire **25** having a density between 1100 and 1400 lbs. per cubic foot. Such wires, for example, may include tungsten, gold, iridium, osmium, platinum, tantalium. Particularly good results have been obtained by using an approximately .003 in. diameter gold plated tungsten wire. The resulting D string **12** has an outside diameter of approximately .021 in.

The G string **13** also includes a plurality of closely associated wires **27** of small diameter impregnated with and bonded together by an elastomer **28**. To make the G string **13** of greater weight the wires **27** are preferably made of a metal having a high density. Particularly good results have been obtained by using 40 strands of approximately .0018 in. tungsten wire. The elastomer **28** for impregnating and bonding together the wires **27** may be similar to the elastomer used in the E string **10**. The resulting core is also tightly wound with a heavy wire **29** having a density between 1100 and 1400 lbs. per cubic foot, and the metals listed in connection with the D string **12** may equally as well be utilized here. Particularly good results have been obtained by winding the core with an approximately .005 in. gold plated tungsten wire. The resulting A string has an outside diameter of approximately .025 in.

Thus, it is seen that each of the violin strings includes

a core having a plurality of closely associated wires of small diameter whereby each of the violin strings is rendered extremely flexible so that it may vibrate more nearly as a string than as a rod, and therefore, give best tonal qualities. Because of the extreme flexibility of the strings damping and resultant decrease in overtones by fingering the strings during playing are maintained at a minimum. Impregnating and bonding together the closely associated wires of small diameter by a suitable elastomer operates to distribute the stresses between the wires making up the core. Thus, the placing of a large tensile force on any of the individual wires of the core with resultant breakage is eliminated. The elastomer, distributing the stresses between the wires forming the core, does not materially affect the flexibility of the core, and yet maximum strength is provided. The elastomer also provides a suitable base about which the wrapping wires may be tightly wound for the purpose of providing the strings with the appropriate weight.

The effective lengths of the E, A, D and G strings are the same, being substantially 13 inches on a violin. The diameters of the E, A, D and G strings are substantially the same, with the maximum difference in diameters between the E string and the G string being less than 50% of the diameter of the G string. When this is contrasted with conventional violin strings where the steel E string is approximately .01 in. and the adjacent gut A string is approximately .03 in., it is evident that the strings of this invention are of substantially the same diameter. For practical purposes, however, it is desirable to have a slight difference in string diameters and preferably the strings progressively differ slightly in diameter in an arithmetical progression. Specifically, it is seen that the difference in diameter between the E, A, D and G strings is about .003 in.

The weighting of the various strings is preferably made such that tuning of the respective strings to the proper pitch is obtained by tensioning the respective strings to substantially the same value. The weighting of the strings is such that the weights thereof progressively increase in a substantially geometrical progression of two, for example, for the 13 in. eflective length of the violin strings the E string weighs substantially .150 gram, the A string substantially .300 gram, the D string substantially .600 gram and the G string substantially 1.200 grams. This geometrical progression of two is particularly adaptable in the case of violin strings wherein the intervals between strings are in fifths.

Since the respective E, A, D and G strings are weighted in accordance with the aforementioned geometrical progression, they may all be tuned to pitch by tensioning them to substantially the same value and in the specific illustration given herein that tension is approximately 15 lbs. For all types of conventional violin strings the tension applied to the E string ranges between 11 to 17.8 lbs., for A strings between 8.5 to 16.5 lbs., for D strings between 8.2 and 12.0 lbs. and for G strings between 8.7 to 12.3 lbs. Since the amount of overtones and hence the harmonic content is determined largely by the tension applied to the strings, it is evident that in the case of conventional violin strings there is considerable deviation in the tonal quality between strings. However, in accordance with this invention wherein the strings are all tensioned to substantially the same value, differences in tonal quality are reduced to a minimum. Hence, it is difficult audibly to detect movement from one string to another during playing of the violin as is the case when conventional strings are utilized.

Thus, there is provided in accordance with this invention a matched set of strings wherein the strings have maximum strength to minimize stretching and breaking, wherein the strings are relatively flexible to provide best tone qualities, wherein the strings are respectively weighted to provide accurate tuning to the desired pitch, wherein the strings are all tensioned to substantially the same value to provide substantially equal tonal quality and wherein the strings have substantially the same diameter to facilitate fingering thereof.

Fig. 3 illustrates a modified form of E string which also gives satisfactory results and which may be satisfactorily related with the other strings although perhaps with not as great a degree of perfection. This modified E string is generally designated at 31 in Fig. 3 and it includes a plurality of closely associated wires 32 of small diameter impregnated with and bonded together by and coated with an elastomer 33. In this arrangement a separate wrapping wire is not utilized. Specifically, the E string 31 may include a 24 strand core of approximately .002 in. diameter high carbon steel wire and the elastomer may consist of a vinyl resin which is built up to provide an outside diameter of approximately .14 in. This string has the desired weight so that it may be tuned to pitch when tensioned to approximately 15 lbs.

While for purposes of illustration various forms of this invention have been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure, and therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. A matched set of strings for a stringed musical instrument comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer, said plurality of related strings having substantially the same effective lengths, having substantially the same diameters with the difference between the diameters of the smallest and largest diameter strings being less than fifty percent of the diameter of the largest diameter string, and having progressively increased weights in substantially a geometrical progression, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

2. A matched set of strings for a stringed musical instrument comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer and a wire wrapped tightly therearound, said plurality of related strings having substantially the same effective lengths, having substantially the same diameters with the difference between the diameters of the smallest and largest diameter strings being less than fifty per cent of the diameter of the largest diameter string, and having progressively increased weights in substantially a geometrical progression, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

3. A string for a stringed musical instrument comprising a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer.

4. A string for a stringed musical instrument comprising a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer and a wire wrapped tightly therearound.

5. A string for a stringed musical instrument comprising a plurality of closely associated high carbon steel wires of small diameter impregnated with and bonded together by and coated with an elastomer.

6. A string for a stringed musical instrument comprising a plurality of closely associated high carbon steel wires of small diameter impregnated with and bonded together by an elastomer, and a metallic wire having a density between 100 to 200 pounds per cubic foot wrapped tightly therearound.

7. A string for a stringed musical instrument comprising a plurality of closely associated high carbon steel wires of small diameter impregnated with and bonded together by an elastomer, and a metallic wire having a density

between 400 and 700 pounds per cubic foot wrapped tightly therearound.

8. A string for a stringed musical instrument comprising a plurality of closely associated high carbon steel wires of small diameter impregnated with and bonded together by an elastomer, and a metallic wire having a density between 1100 and 1400 pounds per cubic foot wrapped tightly therearound.

9. A string for a stringed musical instrument comprising a plurality of closely associated tungsten wires of small diameter impregnated with and bonded together by an elastomer, and a metallic wire having a density between 1100 and 1400 pounds per cubic foot wrapped tightly therearound.

10. A string for a stringed musical instrument comprising a plurality of closely associated tungsten wires of small diameter impregnated with and bonded together by an elastomer, and a gold plated tungsten wire wrapped tightly therearound.

11. A matched set of strings for a stringed musical instrument tuned to intervals of fifths comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer, said plurality of related strings having substantially the same effective lengths, having substantially the same diameters with the difference between the diameter of the smallest and largest diameter strings being less than fifty percent of the diameter of the largest diameter string, and having progressively increased weights in substantially a geometrical progression of two, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

12. A matched set of strings for a stringed musical instrument tuned to intervals of fifths comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer and a wire wrapped tightly therearound, said plurality of related strings having substantially the same effective lengths, having substantially the same diameters with the difference between the diameter of the smallest and largest diameter strings being less than fifty percent of the diameter of the largest diameter string, and having progressively increased weights in substantially a geometrical progression of two, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

13. A matched set of strings for a stringed instrument

comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer, said plurality of related strings having substantially the same effective lengths, having progressively increased diameters in substantially an arithmetical progression of less than twenty percent difference therebetween, and having progressively increased weights in substantially a geometrical progression, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

14. A matched set of strings for a stringed musical instrument tuned to intervals of fifths comprising a plurality of related strings, each including a plurality of closely associated wires of small diameter impregnated with and bonded together by an elastomer, said plurality of related strings having substantially the same effective lengths, having progressively increased diameters in substantially an arithmetical progression of less than twenty percent difference therebetween, and having progressively increased weights in substantially a geometrical progression of two, the arrangement being such that appropriate tuning of the stringed musical instrument is provided when the strings are tensioned to substantially the same extent.

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