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STRING AND PROCESS FOR ITS MANUFACTURE

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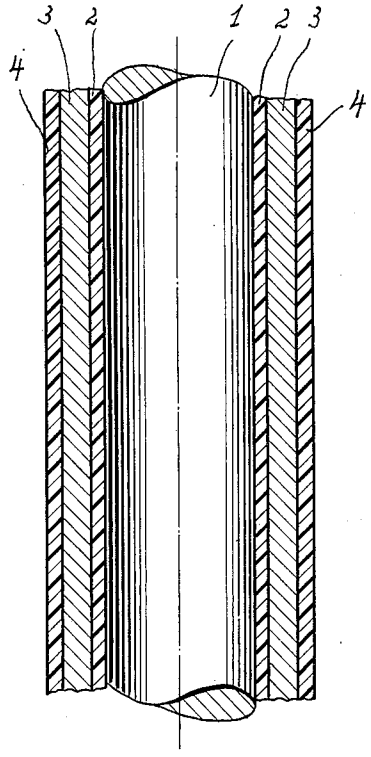

Inventor:
Willi Bayer

by: Michael S. Striker
Attorney

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STRING AND PROCESS FOR ITS MANUFACTURE

Willi Bayer, Ammanstrasse 14, Nurnberg, Germany

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Strings, for example for musical instruments are, for obtaining a certain frequency at a given length and tension in particular for the lower tone positions, provided with an impedance covering. This is effected in known manner by the braiding or plating of a core of metal or non-metal material with metal or non-metal wire, tape or the like. For string the vibrations of which are to be picked up electromagnetically and amplified in addition ferromagnetic braiding material is used. Furthermore it has also been proposed to press around a core an elastic mass which may also be mixed with fibers. In accordance with another suggestion strings are covered with enamel or lacquer.

The fundamental limits of the braiding processes are that the braiding material must comply with a series of requirements as regards density, dimensions, flexibility, tear resistance, hardness, corrosion resistance, appearance and under certain circumstances magnetic properties which in respect of the working procedures when braiding and the materials available are practically not realized to a satisfactory extent. By means of the present invention this plurality of requirements for the impedance material may be limited to the density only and if necessary to the magnetic properties. This is effected according to the invention in that the material is applied around the core in the powder or flake state with the use of a binding medium.

The density of the covering can be adjusted infinitely within wide limits by the density of the powder-like impedance material used and also by the participation of the binding means to a certain extent also by its density. The greatest possible density of the covering with a given impedance material and binding medium is obtained if the portion of binding medium is so small that the individual particles of the impedance material practically contact one another. According to the material used a further increase of the density can be obtained by subsequent treatment, for example, sintering, pressing, rolling or drawing.

In a manner similar to the density of the covering the magnetic properties of same can be varied in manufacture as on the one hand all ferromagnetic metals, metal alloys and metal oxides can be used and on the other hand their effectiveness can be adjusted as desired by the admixing of magnetically indifferent impedance material or by increasing the portion of binding medium.

As impedance materials are considered for example, metals and metal alloys, metal oxides, naturally occurring ores, graphite and also many materials which because of their softness or brittleness could not hitherto be used for the covering of strings.

As binding medium synthetic materials are mainly considered. In order to deposit them in a thin layer on the core they are brought to a thin liquid state which is effected by dissolving in a suitable solution, by emulsifying, by heating or by the use of a monomer in a thin liquid state which is added before, during or after the depositing of a hardening substance or which in the course of the treatment is polymerised in other known manner.

An embodiment of a string according to the present invention is shown in the drawing by way of an example.

The drawing is a partly sectioned partial side view of a

string according to the present invention drawn to an enlarged scale:

Referring now to the drawing it will be seen that the string according to the present invention comprises an inner core 1 which may be made from metallic material. Surrounding the core 1 is a cover layer 3 serving as an impedance material. This cover layer 3 is preferably made from powdered metal. Sandwiched between core 1 and cover layer 3 is a layer of binder material 2 serving to bind the cover layer 3 to the core 1. Surrounding the cover layer 3 and in contact therewith is a thin protecting cover 4 made preferably from plastic which increases the tensile strength of the string and which prevents corrosion of the metallic layer 3. This protecting cover 4 might be in color as desired.

For the application of the covering surrounding centrally the core according to the foregoing principle according to a further invention the following process is indicated: A suitable core of metal or non metal material is uniformly covered in a thin layer with a solution of a binding medium preferably a synthetic material in an easily evaporated solution, for example, acetone. This may for example be attained in that the core is drawn through the solution or the solution is sprayed onto the core or the core is painted with the solution. The same applies with the use of emulsified, melted or monomer synthetic materials.

Directly thereafter the still moist core is covered in a thin layer with the powder serving as an impedance material which can be effected in that the powder is dusted on or the core is drawn through the shaken up or whirled powder and the excess powder not adhering directly to the deposited binding medium is removed by blowing, wiping off or by shaking. In special cases one may also proceed such that one sprays the powder-like heated impedance material onto the already more or less dried core and provided with a layer of binding medium so that a thin layer of the powder is melted onto the binding medium. As a particularly advantageous process for the depositing of the impedance material the electrostatic dusting can be used which is already used in other fields of the technology with oustanding success. This is effected in such a manner that the core is provided with binding medium on the one hand and the particles to be dusted on on the other hand according to basically known methods are provided with electrical charges or opposite signs. The particles flying onto the core in consequence of the electrostatic attractive force meet this with greater kinetic energy the greater the potential differences between the core and the particles to be dusted thereon. According to this process can be deposited on the core particularly densely and because of the radially symmetrical form of the electric field which exists around the cylindrical electrically charged core positively and also very uniformly.

The coating thus obtained according to one of the processes described is finally hardened. This is effected according to the type of binding medium used by treatment with hot air or with heat radiations or with a chemical hardening substance or by it remaining for a sufficiently long time in air at room temperature.

The working sequence of the supplying with binding medium, the dusting with impedance medium and the hardening is now repeated until the string has acquired the desired thickness. The thickness of the layer deposited in one working sequence can be adjusted infinitely variable in a simple manner by the concentration of the binding medium solution as well as by the size of the particles of the powder-like impedance material used.

As the deviation from the centricity during one working sequence can be at the most as great as the thickness of the layer hereby deposited in reality however it only

amounts to fractions and moreover by multiple repetition of the working sequence it is statistically compensated and with the process described positively a satisfactory centricity is ensured. The formation of a preferred direction in cross section of the strings thus produced is not given by outer influence as the core from the moment of the depositing of the layer of binding medium can run completely free of the hardening without having to be touched by any machine parts. An undesired effect of gravity is avoided with certainty by vertical guiding of the core.

The process is suitable in particular for the mass production of strings as it permits of providing a core of any desired length continuously with a covering so that same can afterwards be cut into pieces of strong length and each piece can be provided with a suitable fixing end. This is possible and known with the braiding process but the process according to the invention permits of the simultaneous covering of practically any desired number of cores in one and the same manufacturing plant in that the cores can be allowed to pass through the above described working sequence next to one another separated from one another only by a short distance. In addition the working sequence described can be repeated many times between the rolling off of the core from the supply bobbin and the rolling onto the drawing bobbin or roller so that the core after passing through the plant once is already covered with several layers. It should be emphasized that with the process according to the invention no rotating machine parts other than the bobbins for the winding off and on and no precision machine parts or parts subject to heavy wear are necessary.

If it should be proved to be necesary, for example, with the use of binding medium of comparatively small or inferior value to give the string a resistant upper surface or if with the use of comparatively coarse grained impedance material a smoothing of the surface is desired this can be attained by lingering once or several times with particularly resistant material preferably a synthetic material in accordance with the process according to the invention but without the addition of impedance material. This working procedure is advantageously associated with a dyeing of the string in that pigments or dissolved dyestuffs are added to the material used.

According to a further feature of the invention the strings may be provided with a variegated metallically shining surface of the string made in accordance with the invention or any other desired process is first covered with a thin layer of binding medium then dusting it with a very glossy powder, for example aluminium powder, tin or the like and finally coating it with several layers of transparent synthetic material containing dissolved dye.

In accordance with the process according to the invention the normal non-spun strings such as, for example, the first two strings of a guitar can be provided with a coating which adapted them in their sound characteristic and appearance to the remaining strings of the set and in addition is effective as a protection against corrosion. A covering of the strings of the higher sound positions has not been obtained satisfactorily technically according to the usual processes of braiding as the braiding because of the necessary small thickness becomes easily damaged and under certain circumstances unwinds or moves.

The process according to the invention can be used also for the improving of easily corroded material, for example, iron which is to be used for the braiding of strings in accordance with the usual processes whereby simultaneously with the protection against corrosion a pleasing colouring can be obtained. Finally strings which are produced in accordance with the usual process can be plated so that for example bright iron wire can be used for the braiding.

In conclusion the possibilities of application of the invention for the manufacture of strings the vibrations of

which are to be taken electromagnetically will be described in more detail.

As is known the electromagnetic picking up of sound is effected in such a manner that a string of ferromagnetic material vibrates in a permanent magnetic field which at the same time traverses an induction coil. The vibrations of the string cause a periodic change in the magnetic power flux density whereby a frequency true alternating voltage is produced. This is converted again into acoustic vibrations by the usual electronic amplification.

Now the metal string vibrating in the magnetic field of the sound pick up represents an electric conductor which in consequence of the lack of homogeneity of the magnetic field is passed through by a magnetic power flux of alternating density. In such case however as is known an electrical voltage is induced in the conductor and the current flowing with the current connection now produces on the one hand a magnetic field which is directed against the original magnetic field. In the case of the string the induction current occurs in the form of eddy currents within the metallic mass of the core and covering. These eddy currents may because of the comparatively low ohmic resistance reach considerable strengths. The magnetic fields produced by the eddy currents now have considerable influence on the electroacoustically reproduced string vibrations. To begin with they reduce the sound intensity. Thus it is known that, for example, by braiding with copper wire under otherwise the same conditions the intensity of the sound of a wire in electroacoustic reproduction is reduced. This would not be a very great disadvantage unless the individual strings of a musical instrument were very differently influenced corresponding to their different braiding. Thereby compensating means on the sound pick up are necessary. Another effect of the eddy currents, namely the damping of the string vibration is for the most part not very important but disturb the heterodyning and distortions caused by the inertia of the magnetic eddying field which altogether is expressed in a deterioration of the quality of the sound.

In electro-technology as is known one obtains a suppression of the formation of eddying current in alternatingly magnetised iron cores, for example, transformer cores by subdivision of the iron core into single plates or wires insulated from one another. For the covering of strings the powder-like distribution of the magnetically permeable material is the most suitable. It has only been rendered possible by means of the present invention to use this form of distribution in the covering of strings. In consequence of the fineness of the particles the formation of eddy currents in the covering is practically completely suppressed.

Above all however ferromagnetic materials are usable which by reasons of their mechanical properties are not considered at all as braiding material and in fact according to need materials with very high resonance, for example, so-called magnetic steels as well as those with little remanence and high permeability, for example, silicium containing iron alloys are available. Pure very fine iron powder, for example, so-called ferrom reduction can be used with advantage.

Quite surprising possibilities result however from the applicability of ferromagnetic metal oxides. Such are, for example, magnetite, a mixed oxide of bivalent and trivalent iron or generally the oxides of special type known under the name ferrite in which there is besides trivalent iron another bivalent metal. Such oxides are known in all grades of magnetic properties. Thus there are ferrites with very great coercive force which are summed up under the term ferroxdure types but there are also soft ferrites the so-called ferroxoube types which have a small coercive force but high permeability. They are already used extensively in other fields of the technol-

ogy, for example, in the manufacture of magnetic sound tapes and in high frequency technology.

The outstanding magnetic properties of such ferrites now make it possible to dispense with the steel core of the string completely and to surround a core of synthetic material, for example of the polyamide class, in accordance with the process according to the invention, with a ferrite covering. Thereby the magnetically permeable substance is exclusively placed in the cover. The magnetic and acoustic properties of the string can be brought in the manufacture in a reliable and simple manner to the desired value under certain circumstances by the admixing of magnetically indifferent material. An adverse affecting of the electroacoustic reproduction by the formation of eddy current in the core or by alternating remanence of the core material is now excluded. A further advantage of these strings compared with strings with steel core is their softness to the touch.

If for the covering, ferrites or other ferromagnetic materials with high remanence are used then finally the string can be magnetically polarized to a degree hitherto not obtainable in that in known manner a magnetization is imparted to it perpendicularly to the direction of the core. Such a magnetic polarization of strings has already been tried but had little success because of the slight and very different remanence of the ferromagnetic materials for a long time used for the manufacture of strings. This polarization may according to a proposal already known serve for the compensation of sound intensity in electromagnetic sound pick-up.

According to a further feature of the invention such a polarized string which in fact itself represents a permanent magnet can be used directly for the production of an alternating voltage which in its frequency coincides with the vibration of the string. The vibration of such a string produces already in a simple induction coil amplified by a soft iron or ferrite core the winding plane of which is perpendicular to the polarization plane of the string a frequency true alternating voltage which can be amplified in the usual manner.

What I claim is:

1. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material having a relatively low specific weight, said layer of synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent solid material having a substantially higher specific weight, than the specific weight of said synthetic plastic binder material, said particles of pulverulent solid material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material due to their substantially higher specific weight substantially increasing the weight of said string substantially without affecting the vibratory capacity of said fllamentary core.

2. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material having a relatively low specific weight, said layer of synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a flake-shaped solid material having a substantially higher specific weight than the specific weight of said plastic binder material and being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of flake-shaped material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

3. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent magnetic material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

4. A string according to claim 3, said string being magneticaly polarized.

5. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent metallic material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

6. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material having a relative low specific weight, said layer of synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent magnetically indifferent material having a substantially higher specific weight than the specific weight of said plastic binder material and being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

7. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent ferromagnetic material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

8. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of ferrite being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of ferrite substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

9. A string for a musical instrument and the like, comprising, in combination, a filamentary metallic core; a layer of a synthetic plastic binder material having a relatively low specific weight, said layer of synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent solid material having a substantially higher specific weight than the specific weight of said plastic binder material and being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

10. A string for a musical instrument and the like, comprising, in combination, a filamentary core consisting of synthetic material; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core

without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent solid material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

11. A string for a musical instrument and the like, comprising, in combination, a filamentary core consisting of polyamide material; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of a pulverulent solid material being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent material substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

12. A string for a musical instrument and the like, comprising, in combination, a filamentary core; a layer of a synthetic plastic binder material surrounding and adhering to said filamentary core without substantially affecting the vibratory capacity of said filamentary core; and particles of pulverulent iron being at least partly embedded in said layer of synthetic plastic material firmly adhering to said filamentary core, said particles of pulverulent iron substantially increasing the weight of said string substantially without affecting the vibratory capacity of said filamentary core.

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