Sept. 24, 1968 J. S. GEBBIA 3,402,629

PREASSEMBLED PIANO STRINGS WITH TUNING PIN OR PINS ATTACHED AND METHOD OF MANUFACTURE

Filed April 29, 1964 3 Sheets-Sheet 1

Fig. 1

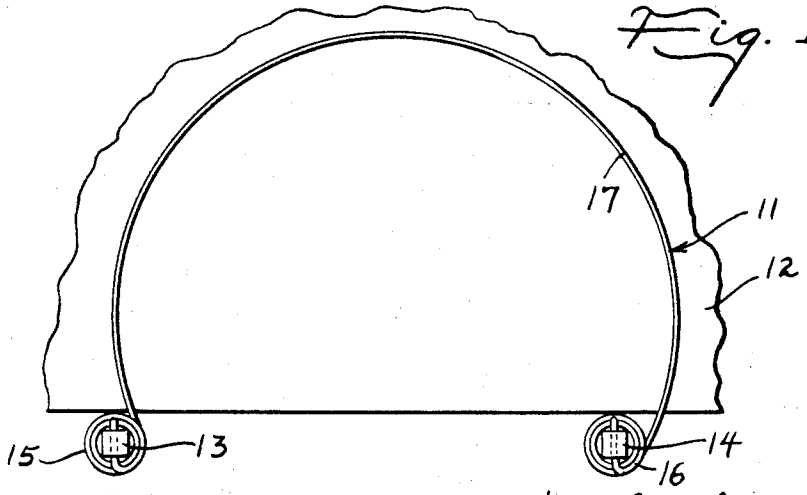

Fig. 2

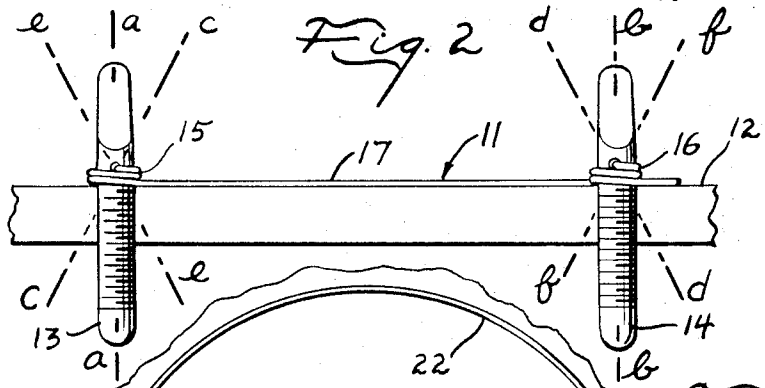

Fig. 3

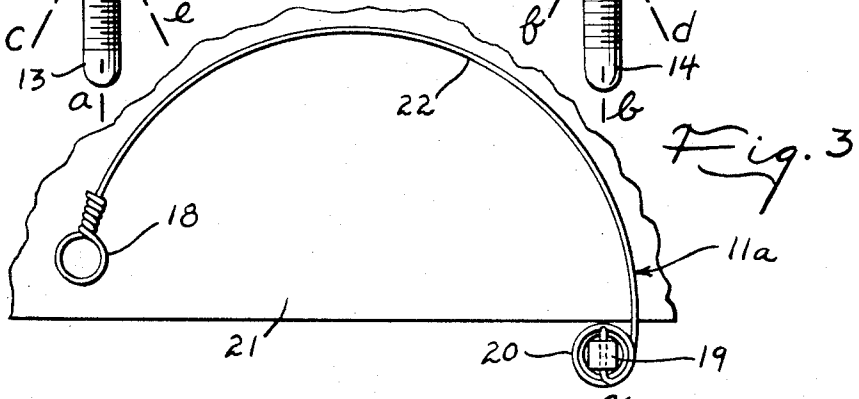

Fig. 4

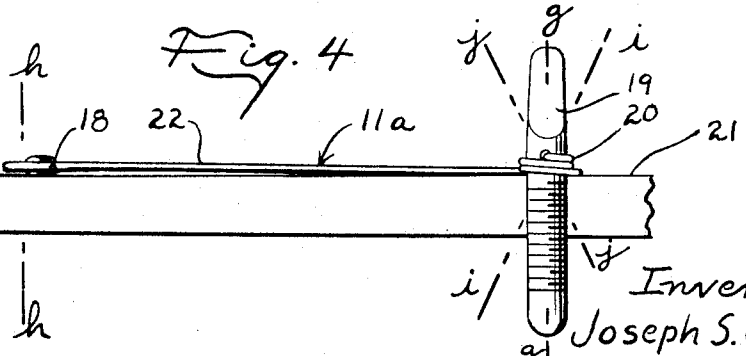

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Fig. 5

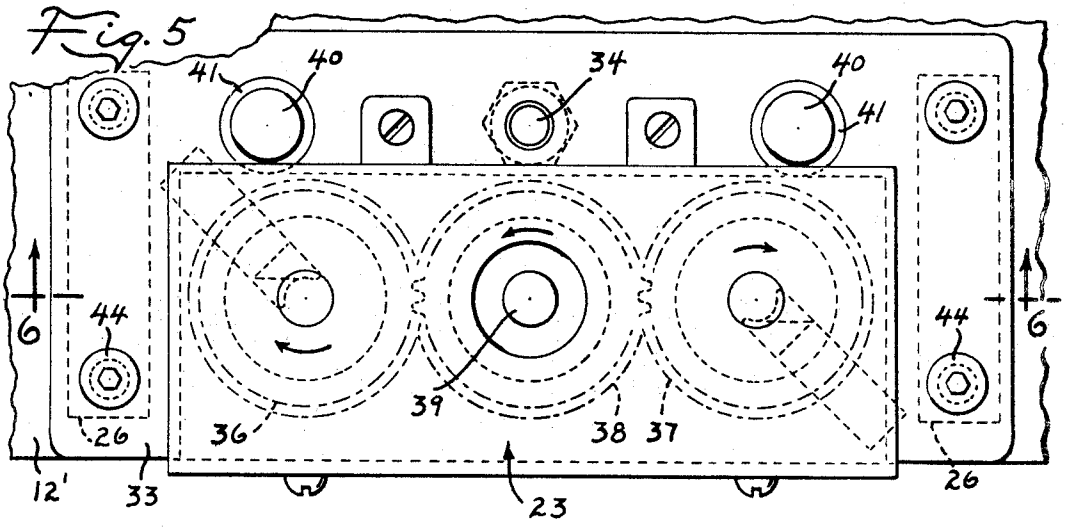
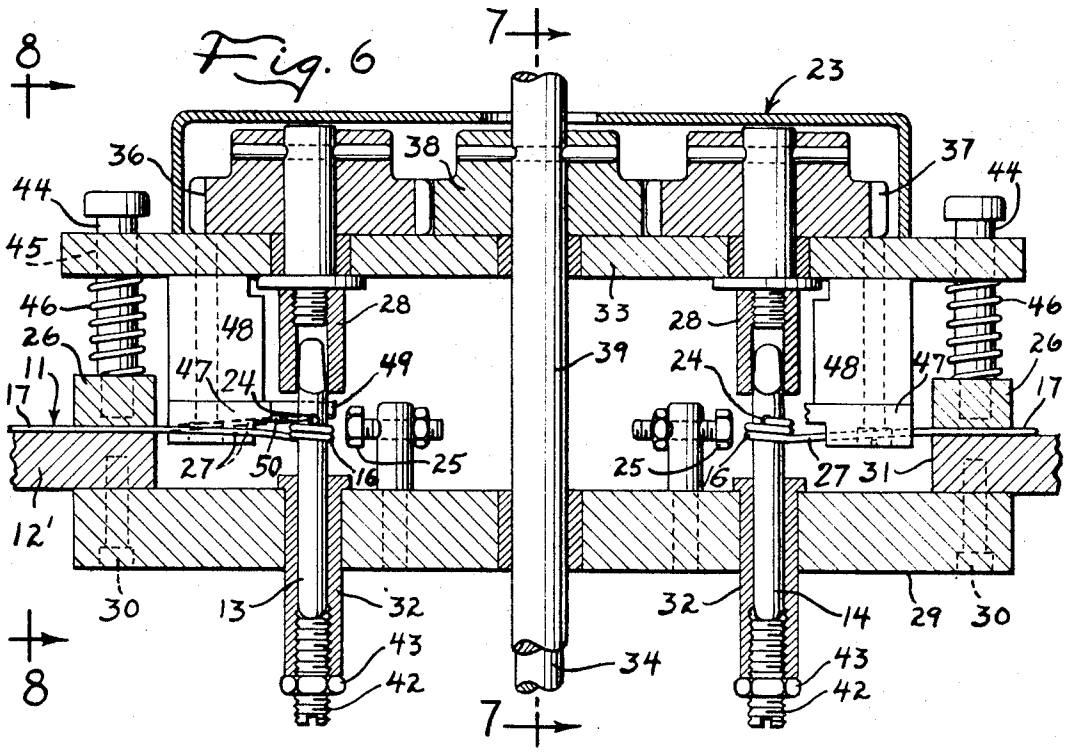


Fig. 6



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PREASSEMBLED PIANO STRINGS WITH TUNING PIN OR PINS ATTACHED AND METHOD OF MANUFACTURE

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Fig. 7

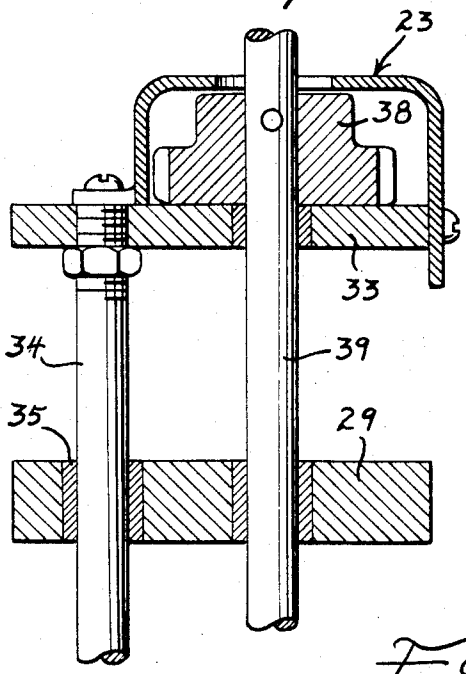


Fig. 8

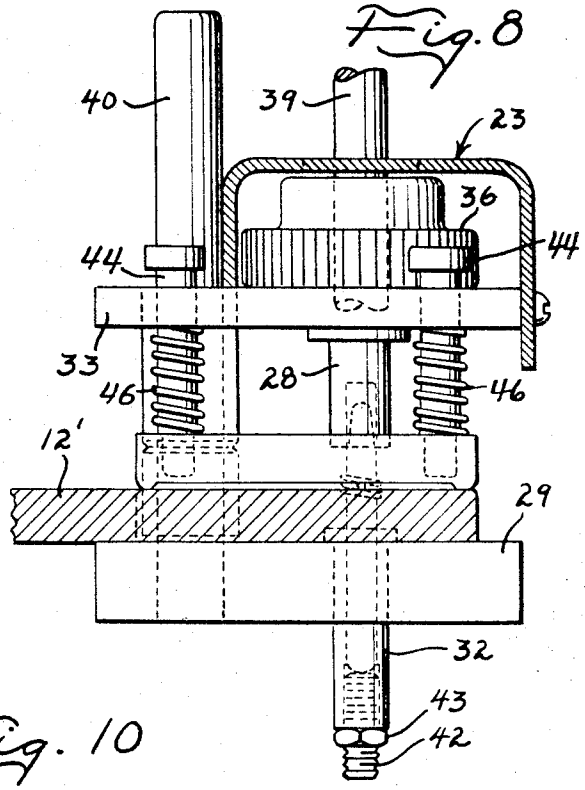


Fig. 10

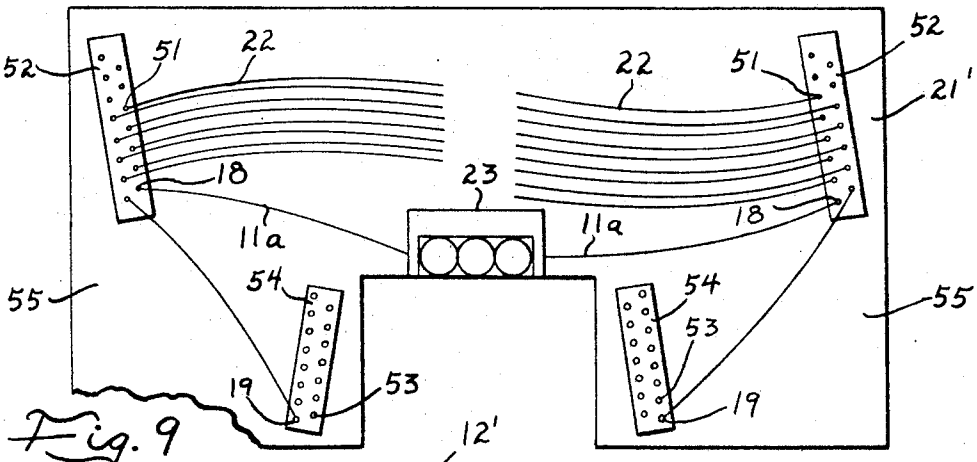
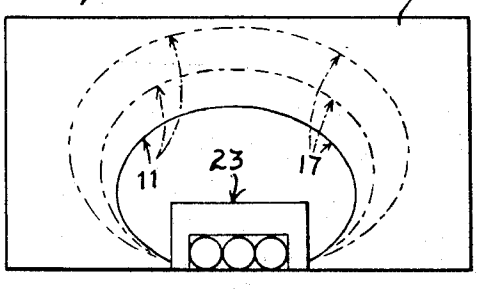


Fig. 9



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3,402,629

PREASSEMBLED PIANO STRINGS WITH TUNING PIN OR PINS ATTACHED AND METHOD OF MANUFACTURE

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ABSTRACT OF THE DISCLOSURE

To save time and expense, and at the same time improve the resulting piano by eliminating the twist in the strings that resulted inevitably with the old hand wound method, this invention provides for precutting of all strings to required lengths, and preassembling of strings on pins by the machine winding of closely and uniformly coiled ends of each string on the tuning pins. Base strings requiring only one tuning pin are made otherwise the same way. All of the strings are cut to the correct lengths and with the coils uniformly wound in tight abutment on the tuning pins, with the strings in relaxed untwisted condition during the coiling, accurate tuning is possible and a big saving in time and money is realized, and workmen don't suffer cuts and scratches, which were always a hazard with the old method due to the cut ends of the wire being so sharp. The resulting piano is also improved due to the fact that the tuner never need compromise and settle for some vibration period as close to what is correct as might be possible, where the note is not too far off on the flat side or on the sharp side.

This invention relates to precut, preassembled piano strings with tuning pin or pins attached by precision coiling of the wire thereon and to the novel method of manufacture of such strings.

In the tuning of a piano with ordinary unimproved strings heretofore available, the tuner was forced to make compromises due to the fact that many strings have uneven strains as a result of uneven thickness of the wire and/or more or less twisting of the wire in the coiling by hand of their end portions on the pins, and false beats are the result. "False beats" means a string is producing more than one given set of vibrations, as for example, a string supposed to vibrate 440 times per second having 442 vibrations will produce a sound wave of 2 beats per second, called false beats. Unevenness in thickness of wire being ruled out as a factor in false beats, there remains only the twisting to be considered and that I eliminate by my invention, as will soon appear. In factories making better grade pianos the more objectionable strings from a standpoint of false beats detected in tuning were taken out and replaced with a view to minimizing the objection mentioned, but the difficulty in my opinion can never be avoided entirely without the use of precut, precision coiled strings in which there is absolutely no perceptible twist in any string, and therefore no unevenness in the strains imposed on the strings when tightened for tuning, and hence no false beats. Realizing that anything that is inherently false cannot be correct, and that it takes three strings to complete a unison or single note, it is apparent that all three strings related in this way must be as closely set in vibrations as possible if the note is to sound right. In other words, if there is one good string and two bad ones the tuner will have a difficult time tuning. A string that beats falsely can never be tuned properly and to tune it slightly off, as a tuner is prone to do, gives a poor result. Piano manufacturers cannot afford to remove strings to correct such defects, as has just been mentioned, as this is very costly especially if the piano has been completely assembled. Everything points therefore to the advisability of putting the strings in correctly to begin with and that is accomplished with my invention. With my inpention I not only enable the quantity production of pianos that can be more easily tuned and will sound better, but, when it is realized that there are from 240 to 250 coils involved in the stringing of a piano, and heretofore all of these coils were made by hand with inevitable unevenness and inevitable twisting of the wire, at high labor costs, for an inferior product, whereas precut, precision coiled strings can be produced in quantities at much lower cost, the importance of the invention is all the more easily appreciated.

The invention also offers other advantages, as for example:

(1) The precut preassembled strings can be brought in sets to the piano assembly line instead of having to move the pianos to the stringer;

(2) The stringer receives the strings marked in numerical order and assembles them in the piano accordingly with much greater dispatch and far less handling of tools;

(3) With all of the strings of a precise length and an exact number of coils rough tuning by mechanical means is made possible as the first operation after stringing;

(4) Closer uniformity in final tuning of pianos in quantity production is made possible, and

(5) Pianos strung in this improved manner will stay in tune longer.

My invention, as will also soon appear, is also concerned with a novel method of and apparatus for producing in quantity production, at low cost, precision coiled, preassembled piano strings of the character described.

The invention is illustrated in the accompanying drawings, in which—

FIGS. 1 and 2 are a plan view and side view, respectively, of a precut, precision coiled string made in accordance with my invention, showing a double pin coil, the two pins of which with the string laid flat and at rest are in true parallelism to one another by reason of the absence of any twist in the wire;

FIGS. 3 and 4 are similar views of another precut, precision coiled string of the eye and pin coil type where again the pin and axis of the eye are in absolute parallelism when the string is laid flat and at rest;

FIG. 5 is a plan view and FIG. 6 a longitudinal section on the line **6—6** of FIG. 5 of a piano string and pin assembling and coiling device made in accordance with my invention;

FIGS. 7 and 8 are cross-sections on the line **7—7** and **8—8**, respectively, of FIG. 6, and

FIGS. 9 and 10 are plan views along the lines of FIG. 5 but on a much smaller scale, showing in FIG. 9 how a double pin coil type treble string like that of FIGS. 1 and 2 has both ends coiled on pins while the speaking length of the string is supported fully relaxed to eliminate any likelihood of any twist being present in the string during the coiling operation, while FIG. 10 is along similar lines showing the coiling of two separate base strings like that shown in FIGS. 3 and 4 at one time on two pins while the eye end of each string is resting flat on a support, so that there is no likelihood of any twist being present in either string during these coiling operations.

Similar reference numerals are applied to corresponding parts throughout the views.

Referring first to FIGS. 1 and 2, the reference numeral **11** illustrates a double pin coil type treble string resting flat in relaxed condition on a flat horizontal support **12** and secured at its opposite ends to a pair of tuning pins **13** and **14** by means of precision wound coils **15** and **16**, the pins **13–14** having their axes *a—a* and *b—b* truly perpendicular to the plane of the string and truly parallel to one another, due to the fact that the string **11** was produced in accordance with my invention, namely, it was

precut to a predetermined length and, while supported so that the entire speaking length **17** of the string was resting in relaxed condition on a horizontal flat support **12'** (FIG. 9), comparable to the support **12**, during the coiling operation, to assure absolute freedom from any twist preliminary to and during the coiling operation, the end portions were precision coiled on the two pins by power. In contrast to string **11**, an ordinary piano string of the old kind now in use, the coils of which were wound by hand the old way, would have the pins **13** and **14** disposed on axes *c—c* and *d—d* or *e—e* and *f—f* in converging or diverging relationship to one another, or even if approximately parallel to one another, certainly not both in right angle relationship to the plane of the string, when the string is laid flat on a support like that shown at **12**. Obviously, any inclination of one or both pins is indicative of twist in the speaking length of the string, and as pointed out above, that is the underlying cause of false beats, which it is the primary object of my invention to eliminate.

Referring next to FIGS. 3 and 4, the reference numeral **11***a* designates another precut, precision coiled base string of the eye and pin coil type, **18** being the eye end and **19** the pin end of the string, the pin being assembled on one end of the string by means of precision coiling as indicated at **20**. Here again, if such a string as **11***a* is laid flat in relaxed condition on a flat horizontal support like that indicated at **21**, the axis *g—g* of the pin **19** is disposed exactly perpendicular to the plane of the string and truly parallel to the axis *h—h* of the eye **18**, showing that the speaking length **22** of the string is completely devoid of any twist, that being the direct result of the fact that in the precision coiling of the string at **20** the string was resting flat in relaxed condition on a horizontal flat table **21'**, as shown in FIG. 10, to eliminate any likelihood of any twist in the wire. In contrast, if a similar string of the old kind now in use, having a hand wound coiling, was laid flat in relaxed condition on a support **21**, there would in practically every instance be some inclination of the pin **19** as indicated by the axes *i—i* or *j—j*, due to a twist present in the speaking length **22** of the string, which it is the main object of my invention to eliminate, in order to eliminate false beats. Two strings **11***a* can be assembled at one time, as illustrated in FIG. 10, the table **21'** accordingly projecting from opposite ends of the coiling unit **23**. Base strings **11***a* of the eye and pin coil type are copper wound but are, for convenience, shown in the same way as the treble strings **11**.

In accordance with my new method, the strings **11** and **11***a* are all cut to the predetermined lengths required and each string is then laid flat on the table **12'** or **21'**, as the case may be, a string **11** having its opposite ends entered through holes **24** in the pins in abutment with stops **25** and then clamped resiliently, as indicated at **26** in FIG. 6, before the coiling is commenced, whereby:

(1) To keep the end portion **27** under a predetermined tension to insure uniformly tight coils at **16** when the Hale hammer tips or chucks **28** are turned mechanically, both in a clockwise direction, for the coiling operation, and

(2) Support the speaking length **17** of the string in relaxed condition in a horizontal plane the full length thereof on table **12'** to eliminate any likelihood of any twist being imposed therein during the coiling operation. For base strings of the eye and pin-coil type shown in FIGS. 3 and 4, the same method applies, but there, the eye end **18** on each of two strings **11***a* is disposed parallel to the top surface of the table **21'** while the other end of each of these two wires is inserted through a hole **24** in the pin into abutment with a stop and then the end portion of the string is clamped in the same way as described above for string **11** before the coiling operation, for the same reasons. FIG. 6 it will be understood, is illustrated as in use, coiling the two ends of a single treble string **11** and that is why the table **12'** is illustrated, instead of the table **21'** of FIG. 10. The units **23** in either case can and will be the same.

Referring now to FIGS. 5 to 8, **29** is a horizontal base plate that is fastened as indicated by screws **30** to the bottom of the table **12'** under the rectangular cutaway portion **31** thereof, and this base plate carries two vertical sockets or receptacles **32** into which the pins **13** and **14** to be assembled on the ends of the string can be inserted while the top plate **33** is held raised by means of a vertical shaft **34** that is reciprocable in a bearing **35** in the base plate **29** and is operated by means of a piston working in an air cylinder (not shown). The Hale hammer tips or chucks **28** are rotatably mounted in the top plate **33** and are operable by means of two gears **36** and **37** driven by a gear **38** disposed therebetween and fixed to a vertical drive shaft **39** reciprocable with top plate **33** and rotatable in coaxially aligned bearings in plates **29** and **33**. Two parallel vertical guide pins **40** fixed to the base plate **29** and working in bearings **41** in the top plate **33** guide the latter for up and down movement, thereby keeping the pin rotating chucks **28** coaxially aligned with sockets **32** and the pins inserted therein and to be driven by said chucks in each coiling operation through two complete turns for the close and accurate coiling of the wire on the pins. Screws **42** adjustable in the lower ends of sockets **32** enable accurately setting the level for the holes **24** in the pins relative to the level of the clamps **26**. Locknuts **43** secure these screws in adjusted position. Clamps **26** are carried on headed pins **44** slidable vertically in holes **45** provided in the top plate **33**. Springs **46** surround the pins between the plate **33** and plates **26** and apply a predetermined amount of pressure on the wire during the coiling operations. Disposed adjacent each of the chucks **28** is a guide finger **47** carried on a vertical support **48** projecting downwardly from the top plate **33**. These guide fingers **47** each have one flat surface **49** bearing against the side of the pin just above the hole **24**, and another flat surface **50** parallel to the surface **49** arranged to bear against the wire and insure close coiling around the pin, the wire when first entered through the hole **24** projecting upwardly at a very small angle with respect to the top of the table **12'** and clamp, and, after two wraps around the end extending downwardly below the plane of the table top at approximately the same small angle, as seen in dotted and full lines in FIG. 6 at **27**.

In operation, spring steel wire is used for piano strings and is cut to the different lengths needed for the different strings of a piano. This will be done in a special cutting machine for cutting all of the treble strings in one set and all of the base strings in one set, using suitable fixtures to insure uniform length for a given note string regardless of what set it is in and to keep all of the strings in a set in a definite numerical order to avoid confusion and save time and labor cost all around in the handling of strings but especially in the final operation of stringing the pianos. Thus, strings are kept in sets when sent to the coiling station, as shown, for example, in FIG. 10, where two sets of base strings **11***a* are illustrated during the coiling of one end on pins. Each string is invariably of arcuate form when free to relax. Such strings when laid flat in relaxed condition on a table **12'** or **21'** will have no twist therein whatsoever, and, if remaining so supported during the coiling operation of one or both ends onto a pin or pins, as shown in FIGS. 9 and 10, there is every assurance that no twist will be present, and hence there will be no false beats when the string is finally assembled with its pin or pins in a piano and tuned. At the start, the operator inserts the two ends of the string **11** through the holes **24** in the two pins while the string is resting in relaxed condition on top of the table **12'**, the top plate **33** being in raised retracted position with the clamps **26** similarly retracted with respect to the top of the table. Then the top plate **33** is lowered by shaft **34** to engage the upper ends of the pins **13** and **14** in the

chucks **28** and at the same time clamp the end portions of the string **11** at **26**, after which the chucks **28** are turned clockwise by power or crank operation of shaft **39** through two turns to coil the wire uniformly and tightly as indicated at **16** on both pins, enough tension being insured by the spring pressure of clamps **26** on the wire at both end portions **27** to insure the same tight coiling on both pins. Obviously, with the entire speaking length **17** of the strings supported in relaxed condition on the table top during the coiling operation, there is no danger of any twist being set up in the wire, and consequently no danger of false beats when the string is subsequently assembled in the piano and properly tuned. What has just been stated regarding treble strings **11** applies equally in regard to the precision coiling on base strings **11***a*, these strings, as shown in FIG. 10, being each assembled to their separate pins, two at a time, as previously mentioned, the eye end **18** of each string lying parallel to the top of the table **21'**, by reason of being looped over pins **51** on flat strips **52** resting on the table **21'**, so that the entire speaking length **22** of each base string **11***a* is resting in relaxed condition on the table top similarly as in the case of treble strings **11**. As each string has its pin **19** assembled on the end opposite the eye **18**, the pin **19** is entered in a hole **53** in another flat strip **54** resting on an extension **55** of table **21'**. The pins **51** are in staggered relation on strips **52**, and holes **53** are arranged in a similar staggered relation in strips **54**. As indicated in dotted lines in FIG. 9, different lengths of treble strings **11** can be accommodated on the table **12'**.

In conclusion I shall give the following comparison between the old procedure now being used and the procedure to be followed with my invention:

(1) With the old procedure (taking at least 90 minutes per piano):

(a) The piano is hauled on a truck to the bench of the stringer. This is necessary because all his spools of wire are there.

(b) The stringer holds a pin in his left hand and with his right hand he grabs the correct wire size and inserts the end of it in a hole in the pin. He then by hand coils the string around the pin using a small crank affair to put pin in motion. He then taps the pin into its hole in the pin plank on the piano. He now brings the string down to a hitch pin and back up to the pin plank and repeats the operation of inserting the string through the hole in another pin, having cut the wire to its proper length before doing the coiling by hand on this second pin. Finally he taps this pin into its hole in the plank. This is done throughout the entire piano. It is impossible with this old method to avoid introducing twist in the wire, no matter how careful the worker happens to be.

(c) Put piano back on truck.

(2) With my new procedure (taking about 12 minutes per piano), a stringer has a truck on which are all of the strings precut and coiled ready for installation. He then goes to where the piano is resting horizontally on a truck and proceeds. All he needs is a hammer to put the already assembled pins in their respective places. The estimated time for pre-cutting and precoiling the precision assembled pins is about 23 minutes, making a grand total of about 35 minutes for a good job as against about 90 minutes for a highly questionable job.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. The herein disclosed method of mechanically, as distinguished from manually, assembling piano strings on pins before assembling the strings in a piano, the method comprising precutting the wire for each string to a predetermined length beyond the speaking length of the ultimate string to allow for an extra end portion length at each end of a double pin coil type string plus enough length at each end for several uniformly tight close coils around a pin to be assembled on each end, supporting the length of wire so cut in relaxed condition on a flat substantially horizontal support, supporting two pins for rotation in right angle relation to the plane of the wire in spaced parallel relation with the ends of the wire entered through diametrical holes in said pins, then frictionally gripping the wire inwardly from both ends so that the entire speaking length of the ultimate string remains supported in relaxed condition on said support during the subsequent coiling, and while the wire remains so supported and gripped mechanically coiling the end portions of the wire on said pins by rotation of the pins to insure uniformly tight close coils on both pins and avoid putting any twist in the wire.

2. The herein disclosed method of mechanically, as distinguished from manually, assembling piano strings on pins before assembling the strings in a piano, the method comprising precutting the wire for each string to a predetermined length beyond the speaking length of the ultimate string to allow for forming an eye on one end and an extra end portion length at the other end plus enough length at this end for several uniformly tight close coils around a pin to be assembled on this end, then, after the eye has been formed on the first end, supporting the wire in relaxed condition on a flat substantially horizontal support with the eye parallel to the surface thereof, supporting a pin for rotation in right angle relation to the plane of the wire with the end of the wire remote from the eye entered through a diametrical hole in said pin, then frictionally gripping the wire inwardly from the latter end so that the entire speaking length of the ultimate string remains supported in relaxed condition on said support during the subsequent coiling, and while the wire remains so supported and gripped mechanically coiling the end portion of the wire on said pin by rotation thereof to insure uniformly tight close coils and avoid putting any twist in the wire.

3. The method of stringing pianos which consists in precutting the wire for each of the strings for a piano to the requisite length, preassembling the tuning pins for all of the strings on the respective strings by mechanically coiling the ends of the wires on the pins in a jig or fixture, as distinguished from winding the wire on the pins by hand, to insure close uniform coiling with uniform tightness per coil, thereafter taking a complete set of strings for a piano to the piano with the individual strings suitably identified so that each can be installed in the piano in its proper location, and installing the strings by means of their pins in the piano.

4. The method of manufacturing piano strings which consists in precutting the wire for each string to a predetermined length, and mechanically coiling the ends of the wire on two piano pins by rotation of the pins while maintaining right angle relationship of the pins to the plane of the wire resting in relaxed condition on a flat support and while maintaining friction drag on the wire short of each pin to insure uniformly tight close coils.

5. The method of manufacturing piano strings which consists in precutting the wire for each string to a predetermined length, and mechanically coiling one end portion of the wire on a piano pin by rotation of the pin while maintaining right angle relationship of the pin to the plane of the wire resting in relaxed condition on a flat support and while maintaining friction drag on the wire short of the pin to insure uniformly tight close coils.

6. The method of manufacturing piano strings which consists in precutting the wire for each string to a predetermined length, forming a loop on one end portion and mechanically coiling the other end portion of the wire on a piano pin by rotation of the pin while maintaining right angle relationship of the pin to the plane of the loop and wire resting in relaxed condition on a flat support

and while maintaining friction drag on the wire short of the pin to insure uniformly tight close coils.

7. As an article of manufacture, a pre-assembled, twist-free piano string for subsequent assembly in a piano, said string being precut to the necessary length and having pins pre-assembled by coils formed mechanically, as distinguished from wound by hand on the opposite ends thereof so that said pins are disposed in exact right angle relation to the plane of the string in true parallelism.

8. As an article of manufacture, a pre-assembled, twist-free piano string for subsequent assembly in a piano, said string being precut to the necessary length and having an eye formed on one end and having a pin pre-assembled on the other end by a coil formed mechanically, as distinguished from wound by hand, so that said pin is disposed in exact right angle relation to the plane of the string and truly parallel to the axis of the eye.

9. In a device for mechanically coiling the ends of a piano string wire on a pair of pins so as to produce a pre-assembled twist-free piano string for subsequent assembly in a piano, said device comprising a substantially horizontal table on which the wire is adapted to rest in flat relaxed condition, a substantially horizontal base plate under an opening provided in said table, two sockets on said base plate for supporting two piano pins for rotation on vertical axes, the pins having wire receiving holes provided therein, chucks disposed in vertically spaced coaxial relation to said sockets to transmit rotation to said pins, means for turning said chucks, and clamp plates or shoes mounted at opposite ends of said device and movable downwardly into engagement with said table outwardly from said sockets to apply friction drag on the wire or wires entered in the holes in the pins while the same are being coiled on the pins and are resting on said table.

10. A device as set forth in claim 9 wherein the means for turning said chucks includes gears on said chucks and a drive gear between and meshing with said gears to turn the same simultaneously in the same direction.

11. A device as set forth in claim 9 including guides for said clamp plates or shoes reciprocable relative to said device, and spring means urging said clamp plates or shoes downwardly relative to said device.

12. A device as set forth in claim 9 including wire guide fingers carried on said device engaging said pins laterally and guiding the wire or wires for close coiling on said pins.

13. In a device for mechanically coiling one end of a piano string wire on a pin so as to produce a pre-assembled twist-free piano string for subsequent assembly in a piano, said device comprising a substantially horizontal table on which the wire is adapted to rest in flat relaxed condition, a substantially horizontal base plate under an opening provided in said table, a socket on said base plate for supporting a piano pin for rotation on a vertical axis, the pin having a wire receiving hole provided therein, a chuck disposed in vertically spaced coaxial relation to said socket to transmit rotation to said pin, means for turning said chuck, and a clamp plate or shoe mounted to move downwardly into engagement with said table outwardly from said socket to apply friction drag on the wire entered in the hole in the pin while the same is being coiled on the pin and is resting on said table.

14. A device as set forth in claim 13 including guides for said clamp plate or shoe reciprocable relative to said device, and spring means urging said clamp plate or shoe downwardly relative to said device.

15. A device as set forth in claim 13 including a wire guide finger carried on said device engaging said pin laterally and guiding the wire for close coiling on said pin.

16. The method of stringing pianos which consists in precutting from spring steel wires as one group all of the treble strings for a piano, precutting from wrapped spring steel wires as another group all of the base strings for the piano, keeping the strings of both sets in numerical order from this point on to their ultimate installation in the piano, and, prior to such installation, applying pins to the opposite ends of the treble strings and to one end of the base strings by precision mechanical coiling, as distinguished from manual coiling, the coiling being done on each string while it is supported in relaxed and untwisted condition, and, finally, while the strings with pins applied are still kept in numerical order, installing the same in the piano.

17. In a device for mechanically coiling one end of a piano string wire on a pin after an eye has been formed on the other end in the plane of the wire, whereby to produce a preassembled twist-free piano string for subsequent assembly in a piano, said device comprising a substantially horizontal table on which the wire is adapted to rest in a flat relaxed condition with the eye substantially parallel to the surface thereof, a substantially horizontal base plate under an opening provided in said table, a socket on said base plate for supporting a piano pin for rotation on a vertical axis, the pin having a wire receiving hole provided therein, a chuck disposed in vertically spaced coaxial relation to said socket to transmit rotation to said pin, means for turning said chuck, and a clamp plate or shoe mounted to move downwardly into engagement with said table outwardly from said socket to apply friction drag on the wire entered in the hole in the pin while the same is being coiled on the pin and is resting on said table.

18. A device as set forth in claim 17 including guides for said clamp plate or shoe reciprocable relative to said device, and spring means urging said clamp plate or shoe downwardly relative to said device.

19. A device as set forth in claim 17 including a wire guide finger carrier on said device engaging said pin laterally and guiding the wire for close coiling on said pin.

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