March 7, 1961 E. L. FRANKE, JR 2,973,533

CLEANING APPARATUS

Filed June 8, 1959 4 Sheets-Sheet 1

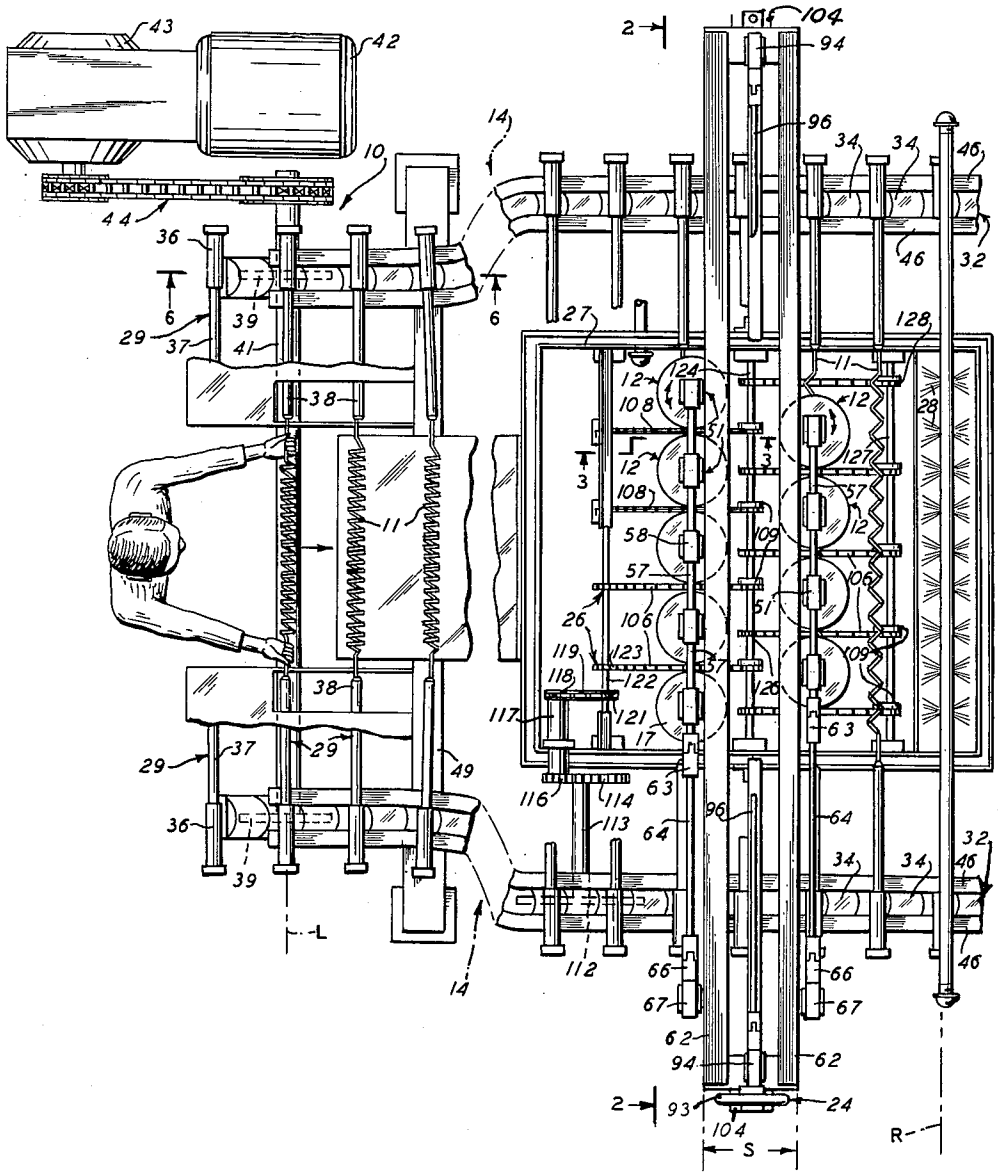


FIG. 1

INVENTOR
E. L. FRANKE, JR.
BY
H. J. Winegar
ATTORNEY

March 7, 1961 E. L. FRANKE, JR 2,973,533

CLEANING APPARATUS

Filed June 8, 1959 4 Sheets-Sheet 2

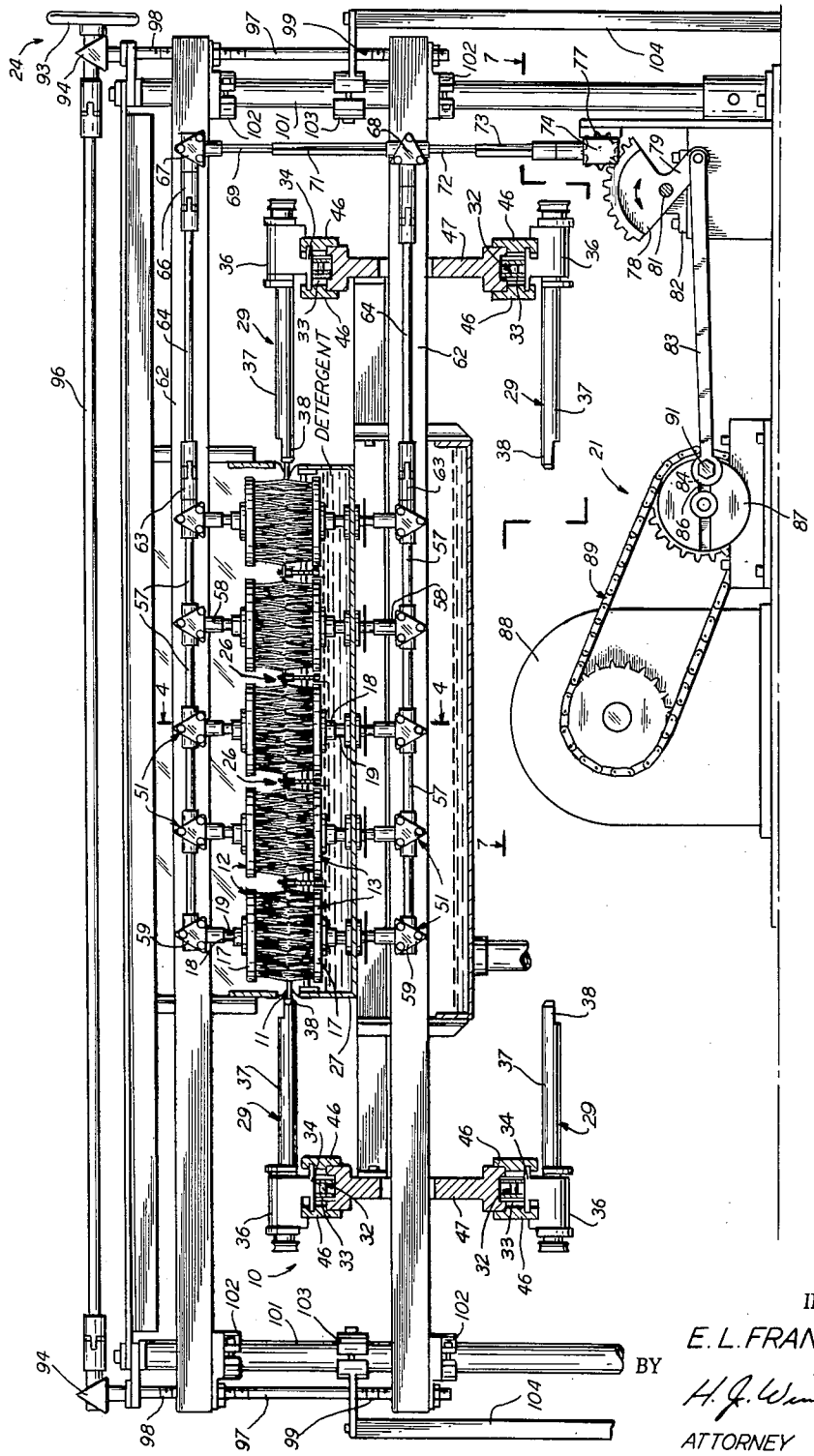


FIG. 2

INVENTOR
E. L. FRANKE, JR.
BY H. J. Winegar
ATTORNEY

March 7, 1961 E. L. FRANKE, JR 2,973,533

CLEANING APPARATUS

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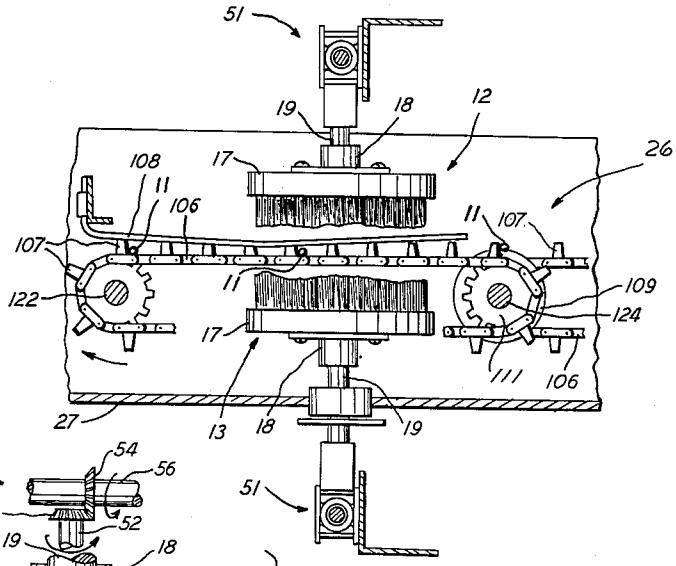


FIG. 3

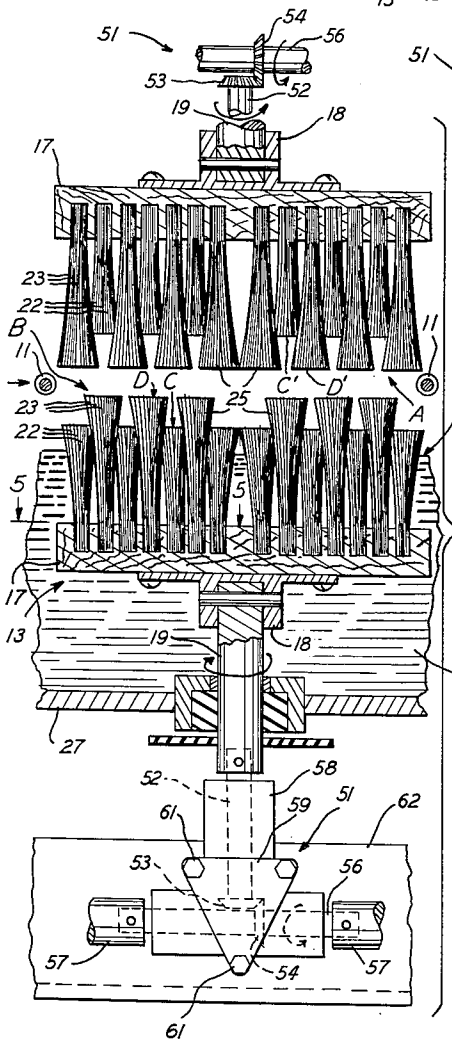


FIG. 4

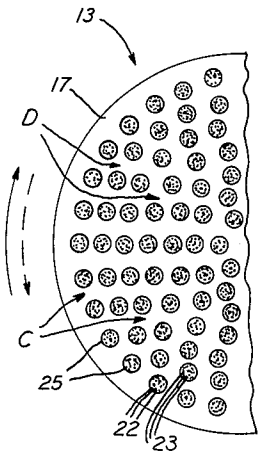


FIG. 5

INVENTOR.
E. L. FRANKE JR.
BY
H. J. Winegar
ATTORNEY

March 7, 1961 E. L. FRANKE, JR 2,973,533

CLEANING APPARATUS

Filed June 8, 1959 4 Sheets-Sheet 4

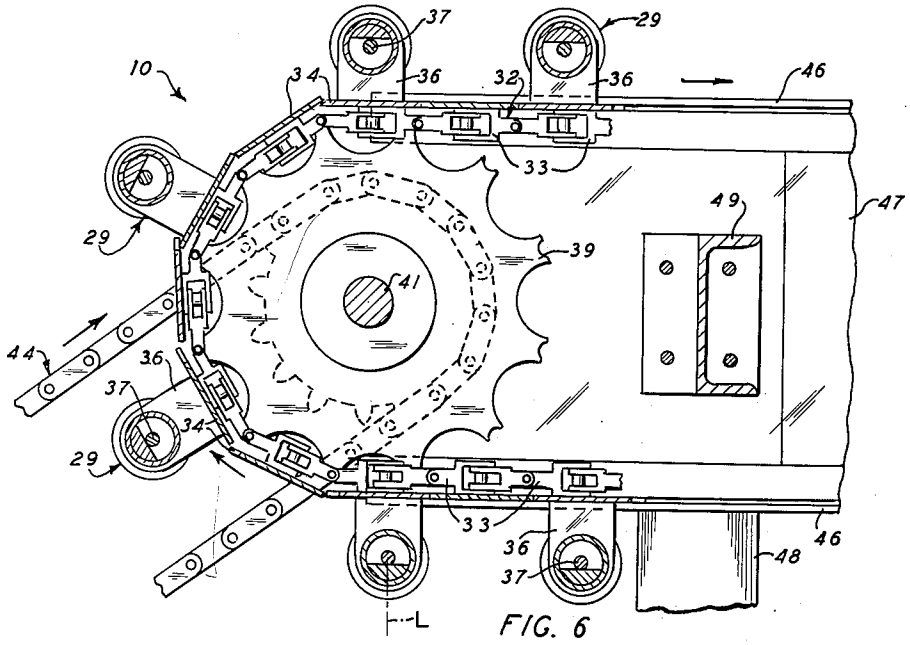


FIG. 6

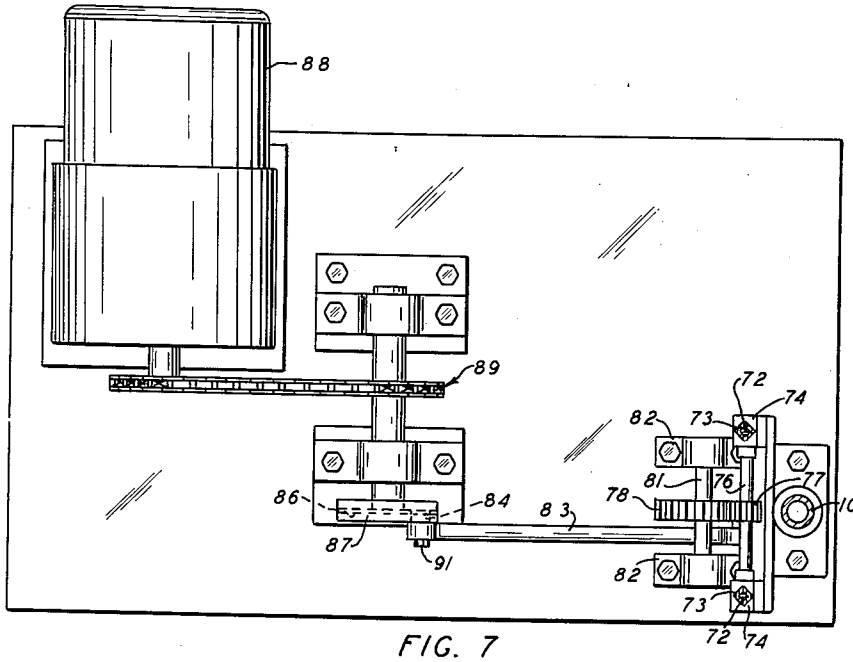


FIG. 7

INVENTOR
E. L. FRANKE, JR.

BY
H. J. Winegar
ATTORNEY

United States Patent Office

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2,973,533

CLEANING APPARATUS

Edward L. Franke, Jr., Cub Hill, Md., assignor to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed June 8, 1959, Ser. No. 818,865

6 Claims. (Cl. 15—21)

The present invention relates generally to cleaning apparatus, and more particularly to apparatus for cleaning a flexible helical article such as a spring cord.

Accordingly, the general object of the invention is to provide new and improved cleaning apparatus.

Another object of the invention is to provide new and improved apparatus for cleaning a flexible helical article, such as a spring cord.

According to a preferred process of manufacturing spring cords for telephone handsets, a desired straight length of jacketed multiconductor cordage is wound in a helix along the length of a rotating and longitudinally moving mandrel, preferably as disclosed in a related copending application of E. C. Hardesty and D. L. Myers, Serial No. 681,035, filed on August 29, 1957, now Patent No. 2,920,351. As disclosed in that application, the cordage is first cut to length, and is then tipped and banded before winding on the mandrel. After the winding operation, the trailing end of the cord is clamped to the mandrel, and then the mandrel with the helical coil clamped thereto is placed in an oven and heat treated.

In a preferred type of cord, the jacketing material comprises a multiply plasticized polyvinyl-chloride composition having elastic properties, as disclosed in a related copending application of V. T. Wallder, Serial No. 529,641, filed on August 22, 1955, and now abandoned. According to that application, a suitable elastic composition comprises 50–70 parts by weight of polyvinyl chloride which may contain up to about 10% of copolymerized vinyl acetate, 15–25 parts by weight of a monomeric plasticizer such as di-2-ethyl hexyl phthalate, 15–25 parts by weight of a polymeric plasticizer such as a dibasic acid-glycol polyester, and minor proportions of suitable stabilizers, lubricants and pigments. The cord is heated on the winding mandrel to a temperature above the softening point of the polyvinyl-chloride composition to relieve strains in the jacketing material and to impart retractility, and is then cooled.

After cooling to room temperature, the heat-treated cord is removed from the mandrel and the pitch of the helix is reversed in order to provide a cord having greater retractility, as disclosed in applicant's related copending application, Serial No. 681,034, filed on August 29, 1957, now Patent No. 2,920,348. As disclosed in that application, an endless conveyor is provided having a succession of opposing, aligned pairs of rotatable clamps mounted thereon for advancement therewith. At a loading station, a succession of cords is inserted between the advancing pairs of clamps, each cord being secured at each end by one clamp. The conveyor advances the clamps in synchronism so that the cords proceed in a direction transverse to their lengths to various operating stations of the machine. At one station along the conveyor, the opposing clamps of each pair are rotated in opposite directions with respect to each other so as to reverse the pitch of the helix and so as to impart a predetermined overtwist to the reversed cord. At a later station, relative rotation of the clamps is caused in the opposite direction

to that of the reversing operation in order to remove the overtwist.

As disclosed in a second copending application of the applicant, Serial No. 812,722, filed on May 12, 1959, and in a copending application of M. W. Richter and D. G. Stetka, Serial No. 812,721, filed on May 12, 1959, a cord-stretching station is provided near the front of the machine. At the stretching station, the advancing cords are deformed into an undulate configuration to separate adjacent convolutions of the cords.

It has been found that in a cord-forming process of this type, specifically one wherein the polyvinyl-chloride composition described hereinbefore is heated above its softening point at one stage in the process, the surfaces of the cords become roughened and scaly. In addition, the cords are likely to accumulate miscellaneous dirt and other surface impurities, which conditions make it highly desirable to scrub the cords thoroughly before they are finished and packaged. Conveniently a scrubbing station, according to the present invention, is incorporated into the spring-cord working machine described in applicant's copending applications between the stretching station and the helix-reversing station.

Accordingly, a specific object of the present invention is to provide a conveyorized apparatus designed for thoroughly scrubbing a succession of spring cords after a heat-treating and a convolution-separating operation and before a helix-reversing operation.

The foregoing and other objects are accomplished, according to certain features of the invention, by poviding a pair of brushes having generally flat circular brushing surfaces, with matingly stepped, concentric rings of bristles being formed on the brushing surfaces thereof. Means are provided for mounting the brushes in alignment with each other so that their brushing surfaces face each other, together with means for causing relative rotation between the brushes.

Preferably, oscillating rotation is caused between the brushes in opposition to each other. Means may be provided for setting the angle of oscillation at any predetermined value between 180° and 300°. In addition, means are also provided for causing relative movement of the brushes toward and away from each other, while the brushes are rotating, to permit adjustment of the spacing therebetween. The spacing is set at a predetermined value between a position where the bristles just contact each other and a position where the bristles overlap by 20%, based on the length of the longest bristles. One brush is preferredly formed with at least five equal width rings of alternating long and short bristles, while the other brush in the pair is formed similarly except that the long and short rings are oppositely arranged.

The cleaning apparatus is particularly useful in the scrubbing of a succession of flexible helical articles, such as spring cords. In this application of the invention, a plurality of aligned pairs of clamps are provided for holding opposite ends of the cord, and an endless conveyor is provided for advancing the pairs of clamps in endless synchronized succession so that the cords are carried, transversely of their lengths, between the opposing pairs of brushes. With this arrangement, a plurality of pairs of brushes are positioned along the line of advancement of the cords so that all coiled portions of the cord pass between at least one opposed pair of the brushes and are thoroughly scrubbed thereby. The brushes are immersed, at least partially, in a detergent solution. In an exemplary arrangement, auxiliary conveyor means are provided for gripping the cords at intervals between the clamped ends thereof and for assisting the end clamps in pulling the cords between the brushes.

Other objects, advantages and features of the invention will appear from the following detailed description of a

specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a plan view with portions broken away of a conveyorized spring-cord working machine illustrating a cord-cleaning apparatus according to the invention and a conveyor for advancing a succession of cords;

Fig. 2 is an enlarged vertical section, taken generally along the line 2—2 of Fig. 1 and illustrating brushes according to the invention, a rotating mechanism therefor, and portions of the conveyor;

Fig. 3 is an enlarged, fragmentary vertical section, taken generally along the line 3—3 of Fig. 1 and illustrating a pair of brushes together with an auxiliary conveyor for pulling a succession of cords between the brushes;

Fig. 4 is an exploded, fragmentary, transverse section through a pair of the brushes, taken generally along the lines 4—4 of Fig. 2 and having portions broken away to reveal structural details;

Fig. 5 is a fragmentary sectional view through the bristles of one of the brushes, taken generally along the line 5—5 of Fig. 4;

Fig. 6 is an enlarged vertical section of a portion of the apparatus illustrated in Fig. 1, taken generally along the line 6—6 of Fig. 1 and showing the construction of a preferred form of conveyor for the cords, and

Fig. 7 is a horizontal sectional view, taken generally along the line 7—7 of Fig. 2 and showing portions of the brush-rotating mechanism.

Referring now in detail to the drawings and in particular to Fig. 1, portions of a conveyorized spring-cord working machine are shown in plan view. The machine includes a conveyor, designated generally by the numeral **10**, for advancing a continuous succession of spring cords **11—11** from left to right, as viewed in Fig. 1. As illustrated in Fig. 1 the cords **11—11** are advanced, transversely of their lengths, from a loading station L, past a scrubbing area S, and then to a rinsing station R.

Referring now to Figs. 2, 3 and 4, in the scrubbing area S, the cords **11—11** are advanced by the conveyor **10** between a plurality of pairs of opposed brushes the brushes in each pair being designated generally by the numerals **12** and **13**. As illustrated in Fig. 1, the pairs of brushes **12—12** and **13—13** are arranged specifically in two offset vertical rows, so as to enable scrubbing of the entire coiled lengths of the cords **11—11** advancing through the scrubbing area S. Preferably, the cords **11—11** advance horizontally and the brush pairs are arranged vertically, although this is not absolutely necessary. It is preferred to provide the conveyor **10** with a diverging section, indicated in phantom lines and designated by the numeral **14**, in order to stretch the cords **11—11** as they pass between the pairs of brushes **12** and **13**.

A preferred brush construction is illustrated particularly in Figs. 4 and 5, it being understood that all of the other brushes **12—12** and **13—13** correspond to those shown in Figs. 4 and 5. Each of the brushes **12—12** and **13—13** is provided with a disk-shaped base **17** having a driving collar **18** fastened thereto. Each of the collars **18—18** is pinned to a stub shaft **19**, and the stub shafts **19—19** of each brush pair are driven oscillatingly rotatably in opposite directions to each other by means of a drive system designated generally by the numeral **21**, best illustrated in Figs. 2 and 7, and to be described in detail hereinafter under the heading "Brush Drive System **21**."

As viewed in Fig. 4, each upper brush **12** has a generally flat, circular brushing surface A, while the corresponding lower brush **13** is provided with a similar brushing surface B. The opposing brushes **12** and **13** are provided with matingly stepped, concentric rings of bristles formed on the brushing surfaces A and B thereof.

In a preferred arrangement illustrated in Figs. 4 and 5, the lower brush **13** is provided with seven alternating rings C and D of short bristles **22—22** and long bristles **23—23** respectively. The rings C and D, at the bases thereof, are preferably of equal widths and it is preferred to provide at least five such rings of equal width with the bristles thereof covering substantially the entire brushing surface of the brush **13**. The upper brush **12** is formed with alternating rings C′ and D′ of short bristles **22—22** and long bristles **23—23** respectively. The rings C′ and D′ are arranged exactly the same as the rings C and D of the lower brush **13**, except that the positions of the short and long-bristle rings C′ and D′ are reversed.

Specifically, the short-bristle rings C′ of the upper brush **12** are precisely aligned with the long-bristle rings D of the lower brush **13**, and the long-bristle rings D′ of the upper brush **12** are aligned with the short-bristle rings C of the lower brush **13**. As illustrated, the two brushes **12** and **13** are exactly aligned in the vertical direction at all times. In operation, the brushes **12** and **13** are moved together, from the exploded position illustrated in Fig. 4, to an operative meshing position indicated in Figs. 2 and 3. Means, designated generally by the numeral **24**, are provided for adjusting the spacing between the brushes **12—12** and **13—13** by moving them toward and away from each other. Such means **24** are best illustrated in Fig. 2 and will be described hereinafter under the heading "Adjusting Means **24**."

In the operative position, the brushes **12** and **13** are in intermeshing engagement with each other so that the long bristles **23—23** of the upper brush **12** contact, and preferably overlap, the short bristles **22—22** of the lower brush **13**. Conversely, the short bristles **22—22** of the upper brush **12** contact or overlap the long bristles **23—23** of the lower brush **13**.

In the machine illustrated, wherein the long bristles are two inches long and the short bristles are one and one-half inches long, it has been determined that an overlap of about one-quarter inch produces best results. This is an overlap of 12½% based on the length of the long bristles. The spacing between the brushes should be adjusted emperically for each application, but the amount of overlap is preferably within the range of from 0% (just touching) to 20%, based on the length of the long bristles.

Preferably, the bristles **22—22** and **23—23** are made of a soft, strong, pliable, and resilient material; specifically a nylon product made by E. I. duPont de Nemours & Company of Wilmington, Delaware and identified as "Tynex." The bristle diameter should be of the order of one hundredth of an inch. The bristles **22—22** and **23—23** are disposed in individual tufts **25—25** of approximately fifty to seventy-five bristles each, with the tufts **25—25** being disposed about one-half inch apart in all directions so as to provide flexibility by allowing considerable bending of the bristles in all directions. The tufts **25—25** are cemented into the bases **17—17** in a succession of circular arrays, as illustrated in Fig. 5, and flare outward from the bases **17—17** in the manner illustrated in Fig. 4. The tufts **25—25** are disposed at such intervals (about one-half inch in the preferred example) that the entire brushing surfaces A and B are substantially covered with the bristles **22—22** and **23—23** and so that there are no bare spaces on the brushing surfaces A and B.

In using the brushes, an article to be cleaned (such as an extended spring cord **11** before described) is advanced between the brushes **12** and **13** in a horizontal plane midway between the bases **17—17**. As the article advances between the brushes, the soft and pliable bristles **22—22** and **23—23** are pushed by the article out of the path thereof so as to allow relatively unrestrained passage of the article. The bristles then spring back to their original positions immediately after the article has passed. Since the bristles **22—22** and **23—23** mesh with each other, and since they are easily deformed, they are bent so as to fit into and scrub thoroughly every contour and external surface of the article. For this reason, these

brushes are especially useful in the scrubbing of a fairly thin article having a complex surface configuration, particularly a flexible helical article such as a spring cord.

As previously mentioned, the meshing brushes 12 and 13 undergo oscillation rotation in opposition to each other, so that relative circular movement is caused between each of the various meshing rings C—D' and C'—D at substantially all times. This oscillating movement has been found highly effective in the cleaning of spring cords. While the brushes rotate in one direction, the bristles are deformed in one direction so as to clean certain surfaces of the cord 11 very well and, upon reversal of the rotation, the bristles are bent in the opposite direction so as to clean the other surfaces of the cord. The angle of oscillation (by which is meant the angle through which each brush is rotated before reversing direction) is best set between about 180° and about 300°, and in the subject machine is preferably set at about 250°. The optimum angle of oscillation depends on various process factors, and is best determined empirically in each individual case.

As previously mentioned, the conveyor 10 operates to advance the cords 11—11 between the upper brushes 12—12 and the lower brushes 13—13. Since the meshing and rotating brush pairs do offer some appreciable resistance to the advancement of the cords 11—11, and since the cords 11—11 might otherwise become twisted in the axial direction by the brushes, it is desirable to provide series of auxiliary conveyors, designated generally by the numerals 26—26, to assist in pulling the cords 11—11 between the brushes. This system is best illustrated in Fig. 3 and will be described hereinafter under the heading "Auxiliary Conveyors 26—26."

As indicated in Fig. 4, the lower brushes 13—13 are immersed in a detergent solution. One suitable detergent solution for the polyvinyl-chloride jacketed cords 11—11 described hereinbefore consists of an aqueous solution of "Igepal," a nonionic polymerized ethylene oxide condensation product manufactured by the General Dyestuff Corporation of New York. As viewed in Figs. 2, 3 and 4, the lower brushes 13—13 fit slidably through sealed apertures in the bottom of a tank 27 containing the detergent.

After the cords 11—11 advance out of the scrubbing area S, they advance to the rinsing station R where water sprays 28—28 (Fig. 1) are directed against the cords 11—11 to wash off the detergent solution and any accumulated, loosened impurities. After the rinsing station R, the cords 11—11 advance to a drying station (assumed to be immediately off the page to the right of Fig. 1). The drying station is in the nature of an oven, open at both ends, wherein the cords are heated by a current of hot air.

CONVEYOR 10

As best illustrated in Fig. 1, the conveyor 10 includes a plurality of aligned pairs of clamps designated generally by the numerals 29—29, each pair being designed for clamping the opposite ends of a spring cord 11. An endless succession of the aligned pairs of clamps 29—29, each carrying a cord 11 therebetween, is advanced from left to right as viewed in Fig. 1 by the conveyor 10. At the loading station L, an operator fastens the ends of a cord 11 between the advancing clamps 29—29, after which the conveyor 10 carries the clamps 29—29 and the cords 11—11 to the various operating stations of the machine.

The clamps 29—29 grip the ends of the cords tightly in order to prevent the cord ends from pulling out of the clamps during the scrubbing and other operations. To enable ultimate reversing of the cords, as mentioned previously, the clamps 29—29 are rotatable; but for the purposes of the present application the clamps are not rotated. If the brushing apparatus disclosed herein were used by itself, then nonrotatable clamps of any suitable type could be provided.

As viewed in Fig. 1, the conveyor 10 includes two endless chains, designated generally by the numerals 32—32, one at each side of the apparatus. As viewed in Fig. 6, each of the chains 32—32 includes a plurality of pivotably connected links 33—33, with a plurality of flat plates 34—34 secured to the outer surfaces of alternate links 33—33. All or some of the plates 34—34 carry a housing 36, within which is journalled a shaft 37 of the clamp 29. In the example illustrated, there is a housing 36 for every second plate 34 in order to provide a desired spacing between the cords 11—11 consistent with the speed of advancement thereof and the operator's ability to insert the cords into the clamps 29—29 at the loading station L. Other arrangements might be utilized in appropriate cases, such as one housing 36 for each plate 34 or one housing 36 for every third plate 34. A clamping jaw 38 is formed at the inner end of each shaft 37.

The links 33—33 of each chain 32 pass around an associated sprocket wheel 39 at the left end of the apparatus, as viewed in Figs. 1 and 6, and about a similar sprocket wheel (not shown) at the right end of the apparatus. The two sprocket wheels 39—39 at the left are keyed to a common drive shaft 41 and are driven from a motor 42, through a gear reducer 43 and a sprocket-and-chain transmission designated generally by the numeral 44. With this construction, the opposed pairs of clamps 29—29 are always aligned horizontally with each other to advance a continuous succession of the cords 11—11 in generally horizontal attitudes, transversely of their lengths, between the brushes 12—12 and 13—13.

The distance between each aligned pair of clamps 29—29 at any point along the line of advancement of the cords 11—11 is controlled by providing a pair of guide rails 46—46 for receiving each of the chains 32—32. The rails 46—46 receive the chains 32—32 therebetween so as to permit sliding horizontal movement of the chains 32—32 under the influence of the motor 42. Since it is desired to diverge the aligned pairs of clamps 29—29 so as to stretch the cords 11—11 previous to advancement thereof to the scrubbing area S, the rails 46—46 diverge uniformly outward on both sides of the machine at the diverging section 14.

In the embodiment illustrated, as best seen in Fig. 2, two identical pairs of the rails 46—46 are secured to the top and bottom of a rail support 47 having an I-channel cross section and being curved to fit the desired path of the conveyor chains 32—32 indicated in Fig. 1. The upper rails 46—46 illustrated in Fig. 2 receive and guide the upper or operating runs of the chains 32—32, while the lower rails 46—46 receive and guide the lower or return runs of these chains. One rail support 47 is provided at each side of the machine, and these members provide the main supporting structure for the conveyor chains 32—32. The supports 47 are mounted above the floor on suitable standards 48—48, one of which is illustrated in Fig. 6. Also, a number of transverse strength members 49—49, one of which is shown in Figs. 1 and 6, are secured between the front and rear rail supports 47—47 at spaced intervals along the length of the machine to provide a rigid, integral supporting structure.

BRUSH DRIVE SYSTEM 21

The drive system 21 for oscillating the brushes 12—12 and 13—13 in opposition to each other through a predetermined angle includes a plurality of right-angle drive units, designated generally by the numerals 51—51, one of which is associated with each of the brushes 12—12 and 13—13 and operates to oscillate a corresponding one of the stub shafts 19—19. One of the drive units 51—51 is illustrated, in detail, at the bottom of Fig. 4 and is typical of all such drive units throughout the apparatus.

As there seen, the stub shaft **19** is formed with a vertical connecting shaft **52** projecting from the lower end thereof and having a bevel gear **53** formed at its lower end. The bevel gear **53** meshes with a similar gear **54**, which is keyed to a horizontal connecting shaft **56**. The shaft **56** is secured between two adjacent stub shafts **57—57**, which shafts run widthwise across the machine and cover the entire area in which there are brushes. The connecting shafts **52** and **56** are received within a T-shaped housing **58**, which is secured by means of a pair of triangular retaining plates **59—59** and a plurality of bolts **61—61** to a main supporting bar **62**.

Comparing the drive units **51—51** at the top and bottom of Fig. 4, it will be noted that, due to the arrangement of the bevel gears **53—53** and **54—54**, when the shafts **56—56** at the top and bottom of the figure are rotated in the same direction, the brushes **12** and **13** are rotated in opposite directions.

As viewed in Fig. 2, there is an upper and a lower supporting bar **62** to support the upper and lower brushes **12—12** and **13—13** respectively, and as viewed in Fig. 1 there is a pair of the supporting bars **62—62** provided for each row of the brushes. As best seen in Fig. 2, the end shafts **57—57** are connected through a pair of universal joints **63—63** to another pair of shafts **64—64**, and then through a second pair of universal joints **66—66** to a further pair of right-angle drive units **67** and **68**, illustrated at the right of Fig. 2.

The input to the right-angle drive unit **67** constitutes a square shaft **69**, which is slidably received within a square sleeve **71** extending upward from the lower right-angle drive unit **68**. With this arrangement, the shaft **69** and the sleeve **71** always turn together, yet the position of the upper bar **62** and the brushes **12—12** carried thereby, may be adjusted with respect to the position of the lower supporting bar **62** and the brushes **13—13**. The input to the lower right-angle drive unit **68** constitutes a second square shaft **72**, which is slidably received within a second square sleeve **73**. The sleeve **73** is connected to another right-angle drive unit **74**, located near the bottom of the apparatus and illustrated also in Fig. 7. The square shafts **69** and **72** and the square sleeves **71** and **73** all turn together as a unit, although each of the square shafts **69** and **71** is slidable within the associated square sleeves **71** and **73**.

As shown in Fig. 7, there are two of the drive units **74—74**, one for each of the rows of brushes illustrated in Fig. 1. The drive units **74—74** are connected to a common shaft **76**, which is driven by a pinion **77** keyed thereto. The pinion **77** is subjected to oscillating rotation by means of a segmental gear **78** in mesh with the pinion **77**. The segmental gear **78** is provided with a tongue **79** (Fig. 2) and is rotatable about a central shaft **81**. The shaft **81** is supported between bearing blocks **82—82** and is freely rotatable with respect thereto.

The segmental gear **78** is rocked by means of an eccentric rod **83**, which is pivotally connected at its right end to the outer extremity of the tongue **79** and which is pivotally connected at its left end to an eccentric block **84**. The eccentric block **84** has a dovetailed surface, and is slidably received within a dovetailing groove **86** formed in the surface of an eccentric wheel **87**.

The eccentric wheel **87** is continuously rotated by means of a motor **88**, through a sprocket-and-chain transmission designated generally by the numeral **89**. As the eccentric wheel **87** rotates, the block **84** is carried in a circular path with the wheel **87** so as to reciprocate the eccentric rod **83** and to rock the segmental gear **78** in well-known fashion. As the segmental gear **78** rocks back and forth, in view of the linkages described hereinbefore, it will be apparent that the brushes **12—12** and **13—13** will oscillate in opposite directions to each other. The angle of oscillation is dependent on the various gear ratios utilized and, specifically, is dependent on the distance of the eccentric block **84** from the center of the eccentric wheel **87**, which distance varies the throw of the eccentric rod **83**.

In order to provide an adjustable apparatus, the eccentric block **84** is slidable in the groove **86** to various positions. A locking nut **91** is provided to clamp the block **84** to the wheel **87** and to the left end of the eccentric rod **83**. The nut **91** may be loosened to allow sliding of the block, and thus setting of the angle of oscillation. In practice, the gear ratios are so arranged and the amount of sliding movement of the block **84** is so arranged that the limits of oscillation of the brushes **12—12** and **13—13** are between 180° and 300°, with the optimum setting being about 250°.

ADJUSTING MEANS 24

The means **24** for adjusting spacing between the brushes **12—12** and **13—13** includes a hand wheel **93**, shown in Figs. 1 and 2, which may be turned by an operator in order to move the brushes **12—12** and **13—13** uniformly toward and away from each other, even while the brushes are rotating. The hand wheel **93** is connected to a pair of right angle drive units **94—94** shown at the upper-left and upper-right of Fig. 2 through a connecting shaft **96**, so as to turn an associated pair of vertical shafts **97—97**.

The threaded shafts **97—97** are received within threaded apertures formed at either end of the supporting bars **62—62**. The shafts **97—97** have a right-hand threaded portion **98** engaging the upper bar **62** and a left-hand threaded portion **99** engaging the lower bar **62**. Thus, it will be obvious that when the hand wheel **93** is rotated slowly in one direction, the two bars **62—62** will be moved toward each other to bring the brushes **12—12** and **13—13** into engagement with each other. Conversely, when the hand wheel **93** is turned in the opposite direction, the two bars **62—62** will be moved away from each other so as to move the brushes **12—12** and **13—13** apart.

In order to allow the above-described movement of the bars **62—62**, they are received slidably on a pair of circular supporting columns **101—101**. A plurality of clamps **102—102** are associated with the bars **62—62** and, when tightened, operate to clamp the bars **62—62** to the columns **101—101**. The columns **101—101** are steadied by means of another pair of clamps **103—103**, which are mounted one each on a pair of supporting standards **104—104**. As previously described, the telescoping drive construction for the brushes **12—12** and **13—13** (utilizing the square shafts **69** and **72** received respectively within the square sleeves **71** and **73**) allows adjustment of the spacing between the brushes without interfering with the rotation thereof.

With this arrangement, it is apparent that the spacing between the brushes may be adjusted precisely, while the brushes are rotating, to that amount determined to enable the most efficient cleaning of the particular article being processed.

AUXILIARY CONVEYORS 26—26

The auxiliary conveyors **26—26** for assisting in pulling the cords **11—11** between the meshing brushes **12—12** and **13—13** are best seen in Figs. 1 and 3. Each of the conveyors **26—26** includes an endless chain **106** equipped with a plurality of lugs **107—107** upstanding therefrom, which lugs are designed to catch the advancing cords **11—11** thereagainst.

Referring to Fig. 1, there is a chain **106** provided between each adjacent pair of brushes **12—12** and **13—13** in the left-hand row and a chain **106** between each brush pair in the right-hand row. All of the chains **106—106** are driven from the main conveyor **10** so that the lugs **107—107** move at substantially the same speed as the cords **11—11** are advancing. As viewed in Fig. 3, the lugs **107—107** are spaced closely, as compared to the spacing between the cords **11—11**. With this arrange-

ment, the advancing cords 11—11 are picked up by the lugs 107—107 just before entering the scrubbing area S without any undue lag between the end portions of the cords, which are carried by the clamps 37—37, and the central portions thereof, which are carried by the lugs 107—107.

A resilient finger 108 is associated with each of the auxiliary conveyors 26—26 and is designed to ride on top of the cords 11—11 being carried by the lugs 107—107. In effect, a pocket is formed for the cords, which pocket is bounded by the chain 106 at the bottom, two adjacent lugs 107—107 on the sides, and the finger 108 at the top. The finger 108 functions to prevent the cords 11—11 from jumping out of the pocket.

A wheel 109 is associated with each of the chains 106—106 near the discharge end thereof, and functions to facilitate discharge of the cords 11—11 from engagement with the carrying lug 107 at the discharge end of the auxiliary conveyor 26. One such wheel 109 is illustrated at the right of Fig. 3, and has a diameter greater than the width of the chain. With this construction, the cord 11 is lifted off of the chain 106 and is thereby prevented from being carried down by the carrying luug 107 as that lug passes around a sprocket 111 at the right end of the chain 106. In this connection, it should be observed that the finger 108 terminates just before the cord 11 advances to the discharge wheel 109, so as to allow the cord 11 to be discharged freely in a region beyond the right end of the auxiliary conveyor 26.

As the cord 11 is so discharged, it is immediately picked up at other positions along its length by similar lugs 107—107 formed on the chains 106—106 associated with the row of brushes 12—12 and 13—13 at the right of Fig. 1. The cord 11 is similarly discharged by corresponding wheels 109—109 near the extreme right of Fig. 1, just prior to advancement to the rinsing station R.

The chains 106—106 are all driven from a sprocket wheel 112 (Fig. 1) which is in meshing engagement with the chain 32 of the main conveyor 10. The support 47 (Fig. 2) for the chains 32—32 is made in two spaced pieces (not shown) at a point along its length to allow reception of the sprocket wheel 112 therebetween.

The sprocket wheel 112 drives the chains 106—106 for the left row of brushes through the following linkages: a shaft 113 keyed to the sprocket wheel 112; a gear 114 fixed to the other end of the shaft 113; a gear 116 meshing with the gear 114; a shaft 117 keyed to the gear 116; a sprocket wheel 118 fixed to the shaft 117; a chain 119 passing around the sprocket wheel 118 and, also, a sprocket wheel 121; a shaft 122 fixed to the sprocket wheel 121, which shaft 122 is coextensive in length with the extent of brushes 12—12 and 13—13; and a plurality of sprocket wheels 123—123 keyed to the shaft 122 at predetermined spaced intervals therealong and about which the chains 106—106 pass, the intervals being so selected that the chains 106—106 run in the spaces between the brush pairs 12—12 and 13—13 in the left-hand row of Fig. 1.

The chains 106—106 associated with the right-hand brush pairs are also driven from the sprocket wheel 112 through the various sprockets and gears just described, the sprocket wheels 111—111 at the right ends of the left auxiliary conveyors 26—26, just described; a common shaft 124 mounted similarly to the shaft 122, which shaft 124 is driven by the left chains 106—106 passing around the sprocket wheels 111—111; and a plurality of sprocket wheels 126—126 keyed to the common shaft 124 at such intervals that the right chains 106—106 run between the brush pairs in the right row. A third common shaft 127 is provided, similar to the shafts 122 and 124, at the right end of the apparatus. End sprocket wheels 128—128 of the right chains 106—106 and end discharge wheels 109—109 are keyed to the shaft 127.

With the foregoing arrangement, it will be apparent that the auxiliary conveyors 26—26 are effective to pick

up the advancing cords 11—11 at approximate intermediate points along the length thereof, to pull the cords 11—11 between the opposing brushes 12—12 and 13—13 of each pair, and to discharge the cords 11—11 freely into space when the cords have passed entirely out of the scrubbing area S.

While one specific embodiment of the invention has been described in detail hereinabove, it will be obvious that various modifications may be made from the specific details described without departing from the spirit and scope of the invention.

What is claimed is:

1. A cleaning apparatus, which comprises a pair of brushes having generally flat circular brushing surfaces, one brush being provided with at least five concentric rings of bristles formed on the brushing surface thereof, which rings are of equal widths and alternately contain long and short bristles, the other brush having similar rings of bristles except that the positions of the long and short bristles are reversed, so that the long bristles of each brush may contact the short bristles of the other brush at the same time; means for mounting said brushes in alignment with each other so that their brushing surfaces contact each other; and means for causing oscillating rotation between said brushes in opposition to each other.

2. Apparatus for scrubbing a flexible helical article, which apparatus comprises a plurality of pairs of brushes having generally flat circular brushing surfaces, with matingly stepped, concentric rings of bristles being formed the brushing surfaces of the brushes in each pair; means for mounting the brushes of each pair in alignment with each other so that their brushing surfaces contact each other; means for causing oscillating rotation between the brushes of each pair in opposition to each other; and means for advancing the flexible helical article, transversely of its length, between the brushes of each pair so that a portion of the article is scrubbed by each brush pair, the brush pairs being so disposed with respect to the line of advancement of the article that the article passes in a substantially straight line between the brushes of each pair and so that all of the helical portions of the article advance between at least one pair of the brushes.

3. Apparatus for scrubbing a succession of spring cords, which apparatus comprises a plurality of pairs of brushes having generally flat circular brushing surfaces, with matingly stepped, concentric rings of bristles being formed on the brushing surfaces of each pair; means for mounting the brushes of each pair in alignment with each other so that their brushing surfaces contact each other; means for causing oscillating rotation between the brushes of each pair in opposition to each other; a plurality of aligned pairs of clamps, each pair being designed for securing opposite ends of a cord; an endless conveyor designed for advancing the pairs of clamps so that the cords are carried in succession, transversely of their lengths, between the brushes of each pair so that a portion of each cord is scrubbed by each brush pair, the brush pairs being so disposed with respect to the line of advancement of the cords that the cords pass in substantially straight lines between the brushes of each pair and so that all of the helical portions of the cords advance between at least one pair of the brushes; and a plurality of auxiliary conveyors designed for gripping each cord in the sequence at points intermediate its clamped ends and for pulling the cord, from the intermediate points, between the brushes of each pair.

4. Apparatus for scrubbing a succession of spring cords, which apparatus comprises a plurality of pairs of brushes having generally flat circular brushing surfaces, with matingly stepped, concentric rings of nylon bristles of the order of 0.01" diameter being formed on the brushing surfaces of each pair; means for mounting the brushes of each pair vertically and in alignment with each other so that their brushing surfaces face each

other; means for causing relative movement of said brushes toward and away from each other while said brushes are rotating to permit adjustment of the spacing therebetween, the spacing being set at approximately one-quarter of an inch overlap; a tank containing a detergent cleaner for the cords, the lower brushes in each pair being slidably received through the bottom of said tank, the liquid level in said tank being such that the detergent solution is available at the interface between the brushes of each pair at the set spacing between the brushes of each pair; means for causing oscillating rotation between the brushes of each pair in opposition to each other, said last-mentioned means being adjusted to provide an angle of oscillation of about 250°; a plurality of aligned pairs of clamps, each pair being designed for securing opposite ends of a cord; an endless conveyor designed for advancing the pairs of clamps horizontally so that the cords are carried in succession, transversely of their lengths, between the brushes of each pair and a portion of each cord is scrubbed by each brush pair, the brush pairs being so disposed with respect to the line of advancement of the cords that the cords pass in substantially straight lines between the brushes of each pair and so that all of the helical portions of the cords advance between at least one pair of the brushes; and a plurality of auxiliary conveyors designed for gripping each cord in the sequence at points intermediate its clamped ends and for pulling the cord, from the intermediate points, between the brushes of each pair.

5. Apparatus for scrubbing a succession of spring cords, which apparatus comprises a plurality of opposing pairs of brushes; a plurality of aligned pairs of clamps, each pair being designed for securing opposite ends of a cord; a main conveyor designed for advancing the pairs of clamps so that the cords are carried in succession, transversely of their lengths, between the brushes of each pair so that a portion of each cord is scrubbed by each brush pair, the brush pairs being so disposed with respect to the line of advancement of the cords that the cords pass in substantially straight lines between the brushes of each pair; and a plurality of auxiliary conveyors designed for gripping each cord in the sequence at points intermediate its clamped ends and for pulling the cord, from the intermediate points, between the brushes of each pair.

6. Apparatus for scrubbing a succession of spring cords, which apparatus comprises a plurality of opposing, intermeshing pairs of brushes; a plurality of aligned pairs of clamps, each pair being designed for securing opposite ends of a cord; a main conveyor designed for advancing the pairs of clamps so that the cords are carried in succession, transversely of their lengths, between the brushes of each pair so that a portion of each cord is scrubbed by each brush pair, the brush pairs being so disposed with respect to the line of advancement of the cords that the cords pass in substantially straight lines between the brushes of each pair, the brush pairs being also mounted in at least two parallel, offset rows with the brush pairs in each row being spaced from each other and with the brush pairs in each row being staggered with respect to the next adjacent row to cover the spaces between the brush pairs in that row so that all of the helical portions of the cords advance between at least one pair of the brushes; a plurality of auxiliary conveyors running in the spaces between each brush pair in each row, said auxiliary conveyors being provided with a plurality of closely spaced lugs projecting therefrom, the lugs being designed for catching each cord in the sequence at points intermediate its clamped ends and in the spaces between the brush pairs in each row and being further designed for pulling each cord, from the intermediate points, between the brushes of each pair, the speed of the auxiliary conveyor being synchronized with the speed of the main conveyor so that the lugs advance at substantially the same speed as the cords are advancing; a plurality of resilient fingers, associated one with each auxiliary conveyor and designed for retaining the cords against the auxiliary conveyor; and a transfer wheel located at the discharge end of each auxiliary conveyor and designed for extricating each cord from the lugs at the intermediate points after each cord has advanced beyond the brush pairs in each row.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,973,533 March 7, 1961

Edward L. Franke, Jr.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 30, for "poviding" read -- providing --; column 9, line 24, for "luug" read -- lug --; column 10, line 1, for "approximate" read -- appropriate --; line 31, after "formed" insert -- on --.

Signed and sealed this 12th day of September 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC