June 7, 1966 J. T. GELARDI 3,254,682

TWISTING MECHANISM

Original Filed Nov. 16, 1962 2 Sheets-Sheet 1

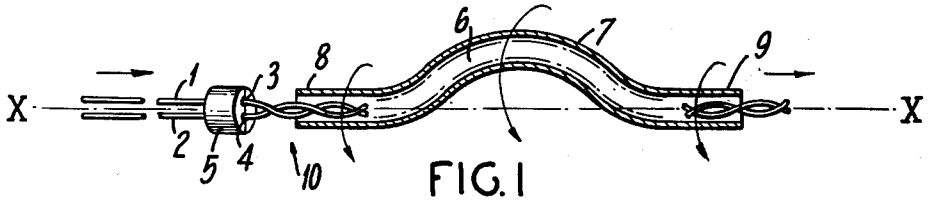


FIG. 1

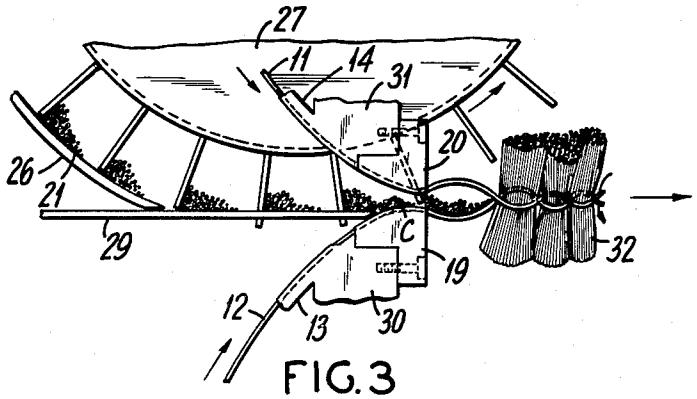


FIG. 3

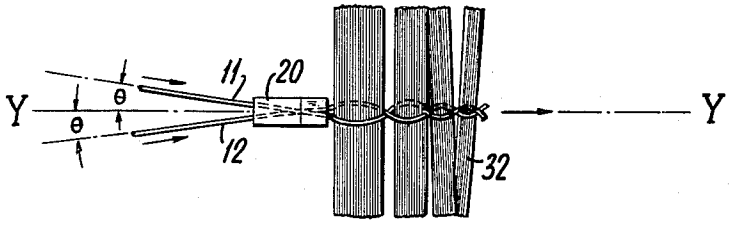


FIG. 4

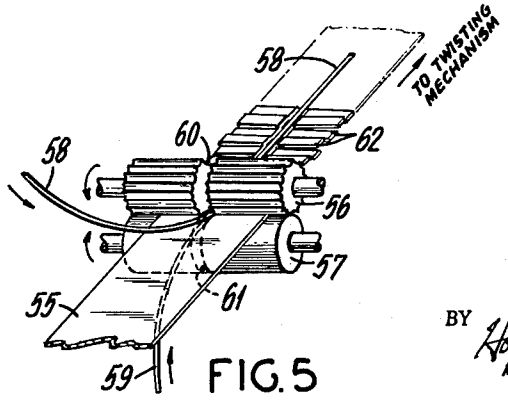


FIG. 5

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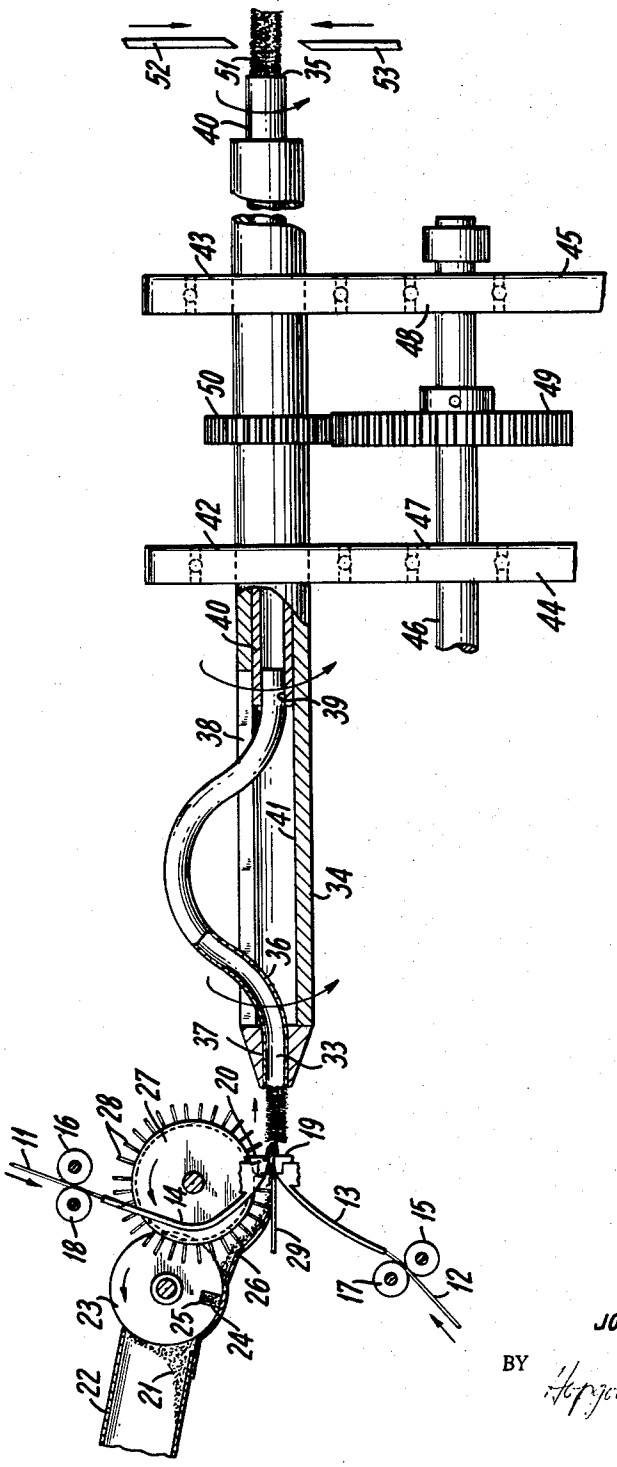


FIG. 2

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TWISTING MECHANISM

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Original application Nov. 16, 1962, Ser. No. 238,247, now Patent No. 3,191,996, dated June 22, 1965. Divided and this application Jan. 6, 1965, Ser. No. 434,157

2 Claims. (Cl. 140—149)

This application is a division of my application Serial No. 238,247, filed November 16, 1962, for Twisting Mechanism, now Patent No. 3,191,996, issued June 22, 1965, which in turn is a continuation-in-part of my application Serial No. 92,657 filed March 1, 1961, now Patent No. 3,160,440, issued December 8, 1964.

This invention relates to the twisting of a plurality of longitudinal members, such as in the production of twisted wire products and, in particular, to a method and apparatus for making twisted wire brushes.

In my Patent No. 3,160,440 I disclose a mechanism for continuously producing twisted wire brushes wherein bristles are deposited between adjacent strands of wire and the twist applied to the strands by applying a force to the bristles. Prior to my pending application, the twisting action was applied directly to the strands of wire by grasping between two supports parallel strands of wire with bristles held therebetween, one of the supports being a rotatable chuck, and by twisting the wires about each other by rotating the chuck. This method had inherent disadvantages in that the operation was intermittent and not readily amenable to continuous operation.

However, I have now found that I can apply a twisting force directly to wire and do it continuously by utilizing a new mechanism and method entirely different from that disclosed and claimed in my aforementioned pending application.

It is an object of my invention to provide an apparatus in which twisted wire products are formed by continuous machine processes rather than by intermittent machine processes by continuously applying the twisting force to the wire strands themselves.

Another object is to provide a method for continuously producing twisted wire products.

A further object of the invention is to provide a method and apparatus for continuously producing twisted wire brushes.

These and other objects will more clearly appear to those skilled in the art from the following disclosure in connection with the accompanying drawings, wherein:

FIG. 1 is a representation of one embodiment of the invention as applied to the twisting of two strands of wire;

FIG. 2 depicts another embodiment of the invention as applied to the continuous production of twisted wire brushes;

FIGS. 3 and 4 show in detail one embodiment of a mechanism for feeding and depositing brush bristles between adjacent strands of wire prior to the twisting thereof into a brush element; and

FIG. 5 is illustrative of an embodiment for feeding bristle-forming material in the form of a continuous web of material between adjacent strands of wire to a set of rolls adapted to sever the web partially transversely and form bristles therefrom.

Stating it broadly, the method aspect of my invention comprises providing a plurality of adjacently arranged strands which are guided along a longitudinal axis during which a portion of said adjacent strands are caused to follow a path laterally offset relative to the longitudinal axis and then returned thereto. As the strands traverse the offset path, a force is applied to the strands at the offset portion, whereby the offset portion of the strands is caused to rotate and describe a surface of revolution about the longitudinal axis in opposition to a reacting force set up near a region of said strands before the offset portion. This results in a rotary force applied to the strands, whereby the strands are caused to twist about each other.

FIG. 1 is illustrative of one embodiment of my invention. A pair of wire strands **1** and **2** are fed from wire reels (not shown) through apertures **3** and **4**, respectively, of a split die **5**. The corners of the die apertures are rounded to minimize nicking and scoring of the wire entering and leaving the die. As the strands of wire leave the die, they are caused to enter a hollow longitudinal passageway of a tubular member **6**, a portion **7** of which is offset laterally from the axis X—X of its entrance portion **8** and returns to said axis at its exit portion **9**. Thus, a portion of the adjacent strands of wire is caused to offset laterally relative to the axis. By applying a force at the offset, for example by rotating tubular member **6** about axis X—X as shown in FIG. 1, a rotary twisting action is conferred to the wire near the region **10** before the offset in opposition to a reacting force set up at the die which is fixed relative to the rotating tubular member. As the strands of wire are fed through the die and on through rotating tubular member **6**, they are continuously being twisted.

The apparatus aspect of the invention comprises a tubular member adapted to receive and permit passage therethrough of a plurality of adjacent strands of wire, said tubular body being characterized by a portion which is offset laterally from the axis of the entrance portion and returns to said axis, means for rotating said tubular body about said axis and means for setting up a reacting force on said strands of wire in opposition to the force applied to the strands at the offset portion.

Another embodiment of my invention as applied to the production of twisted wire brushes is shown in FIGS. 2 to 4 wherein the bristle and wire feeding mechanism are similar to those disclosed in my previously mentioned copending application. Referring to FIG. 2, continuous wires **11** and **12** are preferably, although not necessarily, driven from storage reels, not shown, into corresponding guide tubes **13** and **14** by friction drive rollers **15** and **16**, which are rotated by means not shown in synchronism with each other to produce a desired wire feed rate. Friction drive rollers **15** and **16** are pressed against their respective wires, the wires being supported by idler rollers **17** and **18**. Guide tubes **13** and **14** keep their respective wires from buckling under the driving force, and deliver their respective wires to a pair of spaced feed jaws **19** and **20**. Structural elements **13** to **18** can be made of any suitable material, and the means for driving rollers **15** and **16** can be any suitable rotary drive means, many of which are well known to those skilled in the art.

The bristles for the brush body are laid between wires **11** and **12** in the space separating jaws **19** and **20** by a picker wheel-pin wheel combination similar to those used in prior art machines. If desired, a multi-slotted wheel may be used in place of the picker wheel-pin wheel combination, the two being functionally equivalent. Suitable bristles **21** are stored in hopper **22**, which bristles may be gravity fed, as shown, but which preferably includes means not shown for applying a feed force to the bristles therein. Bristles **21** are removed from hopper **22** by a rotating pick-up wheel **23** which is relatively wide in its axial dimension and which contains a picker slot **24** cut into the periphery thereof. Picker slot **24** is preferably fitted with an adjustable bottom **25** which can be raised or lowered to change the bristle capacity of the picker slot **24**.

With each revolution of picker wheel **23**, picker slot

24 moves across the open end of hopper 22 and receives a charge of bristles which it subsequently dumps on the inclined portion of bristle guide surface 26. The bristles are then picked up by a dual pin wheel whose symmetrical wheel members are arranged to overlap a portion of picker wheel 23, and whose pins sweep past the bottom of the inclined portion of bristle guide surface 26. Only one-half of the pin wheel structure is shown in the drawings (wheel 27 and its associated pins 28) but it will be understood by those skilled in the art that the assembly contains another wheel, not shown, which is identical to wheel 27 and which is mounted on the same shaft with its pins in alignment with pins 28.

The pins of the pin wheel assembly pick up the bristles dumped out of the picker slot 24 and carry them downward along the lower curved portion of guide surface 26, which merges with a pair of bristle guide rails at its low end. Only one guide rail (rail 29) is shown in the drawings, but it will be understood by those skilled in the art that a second guide rail, not shown, is mounted parallel to guide rail 29. The bristles are driven along the guide rails and are released at the point where the pins of the pin wheel assembly rise above the bristle guide rails.

Picker wheel 23 and pin wheel 27 are driven by means, not shown, at some predetermined speed to lay bristles between wires 11 and 12 at the desired rate which is dependent on the wire feed rate and the bristle density required in the finished brush. The selection of such speeds, however, will clearly appear to those skilled in the art, as will the other adjustments or structural modifications required to lay bristles at any desired rate between wires 11 and 12.

The release point for the bristles is located in the space separating wire feed jaws 19 and 20, preferably at or slightly forward of the vertical center thereof as more clearly shown in FIG. 3. The purpose behind this particular location will become more apparent from a detailed description of wire feed jaws 19 and 20, which are adapted like die 5 of FIG. 1 to act as reacting members to twisting forces developed on wires 11 and 12 by rotation of the tubular member through which the strands of wire travel.

Jaws 19 and 20 are rigidly attached to fixed frame members 30 and 31, which are rigidly attached to or form a part of the frame structure, not shown, which supports the bristle feed and wire drive assemblies. Each of the jaws has a wire guide channel formed in the surface thereof, as indicated by the dotted lines which follow the surface curvature of the jaws in the elevation view of FIG. 3 and which are skewed with respect to each other by an angle θ referred to longitudinal center line Y—Y as shown in the plan view of FIG. 4.

The radius of curvature of the wire guide channels is preferably selected to match as close as possible the natural curvature that would be produced in wires 11 and 12 at the normal twisting rate thereof. As shown in FIG. 3, the curvature of the wire guide channels is modified at the wire inlet end to match the angle at which the wires 11 and 12 are delivered to their respective jaws. These angles are preferably in the neighborhood of 45° above or below the horizontal center line of the machine, although smaller or larger inclinations can be used, depending on the application. The outlet end of the wire feed jaws is placed slightly forward of the center thereof, where "center" is taken to mean the point on the curvature where the tangent to the curve is horizontal, as indicated by the letter "c" in FIG. 3.

The wire guide channels of the two jaws as stated hereinabove are skewed with respect to each other so as to oppose the twisting of the wires, as shown in FIG. 4. This skewing serves three purposes, (1) it presses the wires against the sides of their respective guide channels so that they will not slip out when the machine is stopped, (2) it prevents the twisting forces from being communicated back into the wire storage reels, and (3) it spreads the first twist in the wires to form a pocket in which the bristles can be laid.

The bristles are laid in the pocket formed by the first standing twist in wires 11 and 12 at or slightly forward of the center of jaws 19 and 20, which obviates any tendency of the bristles to slide backward on the downward curve of lower jaw 19. This is done by adjusting pin wheel 27 so that pins 28 rise above bristle guide rail 29 at the center of the jaws. The exact point of release is not critical, but it should not be so far forward that pins 28 catch on the bristles laid in the pocket by a preceding pin. It will be noted that the standing twists in the wire get progressively smaller until they reach a relatively tight twist at some distance forward of the jaws in the region before the offset of the tubular member to be described later. This smooth progression provides a natural feeder mechanism for feeding each bundle of bristles 32 smoothly and uniformly into the tight twist. This progression, which is enhanced by the spreading effect of the skewed wire guide channels, prevents the bristles from being driven backward when pinched between the twisted wires.

Concurrently the wires emerging from the jaws are being twisted together by rotary forces applied thereto by the twisting mechanism into which the wires and the bristles deposited therebetween are fed. The wires and the deposited bristles enter passageway 33 of tubular member 34 and exit the passageway completely twisted at 35. The initial portion of the passageway is formed of an arcuate tube member 36 which starts off being coaxial with tubular member 34 at mouth portion 37 and then offsets laterally from the axis through a cut-out portion 38 of member 34 and returns to said axis at 39, where it emerges coaxially with the passageway of tube 40 telescoped within bore 41 of tubular member 34 and emerges at the far end thereof as shown in FIG. 2.

The rotation of tubular member 34 can be effected by any suitable drive means, for example, by any arrangement of variable speed belt and pulley system or by gearing means. In the embodiment shown in FIG. 2, the tubular member is journalled through bearings 42 and 43 supported within frame members 44 and 45 which are attached to or form part of a supporting frame work not shown in the drawings. The rotatably mounted tubular member 34 is driven by shaft 46 which is also journalled through bearings 47 and 48 to frame members 44 and 45, by means of drive gear 49 which meshes with driven gear 50.

As tubular member 34 rotates, the wire strands passing through offset tube 36 are caused to describe a surface of revolution relative to the longitudinal axis of the tubular member and since jaws 19 and 20 are fixed relative to the rotation of the member, reacting forces are set up on the strands of wire, as a result of which the strands twist about each other. As brush element 51 is twisted, it passes on through the tubular member and exits at 35 where it may be cut to desired lengths by cutting dies 52 and 53. If desired, the bristles may be trimmed first to uniform lengths prior to cutting the brush element by means of a trimmer as described in my copending application.

It should be noted, though, that since the brush body is continuously driven, the cutting dies will momentarily interrupt its travel, so that the cutting dies should not be located too close to the trimmer or wire twisting element. A large enough gap must be maintained to permit the brush body to bow out when its travel is interrupted, without reflecting the interruption back into the wire twisting element, whose twisting effect is dependent upon feed rate. If the brush body must be cut close to the trimmer, this is preferably accomplished by guiding the brush body around a turn after it leaves the trimmer and cutting it after it rounds the turn. This arrangement

produces a ready-made bow which expands when the cutting dies snap shut and contracts when they open. And in cases where the above-noted cutting arrangements are unsatisfactory, the brush body can be cut by means of an electric arc which flashes across the brush body and melts the wires thereof. With an electric arc cutter there would be no interruption of the brush feed, and the brush body could, accordingly, be cut right next to the trimmer.

It should be noted, however, that it is not necessary to cut the brush body in short lengths; it could be rolled up on large storage reels if desired, the reels being rotated about one axis in synchronism with the brush feed rate and being rotated about another axis in synchronism with the brush rotation. This can be done, as will be understood by those skilled in the art, by mounting the take-up reel in a gimbal structure which allows the reel to simultaneously rotate about two perpendicular axes.

While FIGS. 2 and 3 show one method of feeding and depositing bristles between wire elements, it will be appreciated that the invention is not necessarily limited thereto. For example, bristle-forming material may be employed as the starting material, and the bristle elements formed therefrom after depositing the material between adjacent wire elements. One embodiment is shown in FIG. 5 wherein the bristle-forming material comprises a web **55** which is continuously fed between rotatable roll dies **56** and **57** simultaneously with wire strands **58** and **59**, one strand above the web, the other below. Each roll is characterized by centrally-located wire guide annular detents **60** and **61** which in registry provide an opening to enable the strands to pass between the rolls while in touch with the web. The surface of upper roll **56** is provided with a plurality of spaced ridges in the form of cutting edges for slitting the web transversely as it passes between the contacting rolls, except for the longitudinal center portion of the web which passes unsevered through the opening between the rolls. Bristles **62** are thus provided which together with the wire strands enter the twisting mechanism of the general type illustrated in FIGS. 1 and 2.

I find the foregoing embodiment particularly suited for producing continuous lengths of twisted wire products for use as Christmas tree or similar decorations. Thus, web **55** might comprise thin aluminum foil of the tinsel variety or colored paper or plastic material. Or if desired, two or more layers of web can be fed simultaneously, one in the form of thin aluminum foil, the other as colored paper, whereby to produce a twisted wire product exhibiting an interplay of several or more colors. The opening formed by the roll dies which provides the pathway for the wire strands through the rolls also serves in setting up a force opposing the force set up by the twisting mechanism for causing the wire strands to twist about each other.

While the foregoing description sets forth the principles of the invention in connection with specific apparatus, it is to be understood that this description is made only by way of example and not as a limitation of the scope of the invention as set forth in the objects thereof and in the accompanying claims, in which the word "twisted wire product" is meant to cover any product in which twisted wire strands make up one element of the product, in which the word "brush" is defined to mean any brush-like article or structure, the word "bristle" to mean any relatively short transverse member, however soft, the word "wire" to mean any relatively long twistable member, however rigid, and the words "brush body" to mean a plurality of wires having bristles spaced thereinbetween, whether twisted or untwisted.

While the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

What is claimed is:

1. A method for continuously producing twisted wire brush elements which comprises guiding a plurality of adjacently arranged strands of wire with bristles deposited therebetween in a path lying along their common longitudinal axis, a portion of said path being laterally offset from said axis and returning thereto, causing said adjacent strands with the deposited bristles to follow said path laterally offset from said axis and return thereto, applying a force to said strands at said offset portion to cause said offset to rotate about the longitudinal axis and describe a surface of revolution about said axis in opposition to a reacting force set up near a region of said strands before said offset portion, whereby said strands are caused to twist about each other near said region and lock the bristles therebetween.

2. A method for continuously producing twisted wire brush elements which comprises guiding a plurality of adjacently arranged strands of wire in a path lying along their common longitudinal axis, a portion of said path being laterally offset from said axis and returning thereto, depositing bristles between said strands of wire, causing said adjacently arranged strands and contained bristles to follow said path laterally offset from said axis and return thereto, applying a force to said strands at said offset portion to cause said offset to rotate about the longitudinal axis and describe a surface of revolution about said axis in opposition to a reacting force set up near a region of said strands before said offset portion, whereby said strands are caused to twist about each other near said region and lock the bristles therebetween, and removing the twisted wire brush elements as they form.

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