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Title:- APPARATUS FOR MANUFACTURING CONTINUOUS ZIGZAG
COUPLING ELEMENTS FOR SLIDE FASTENERS

Description:-

The present invention relates to an apparatus for manufacturing continuous zigzag coupling elements of thermoplastic resin for slide fasteners from a linear filamentary material.

5 Japanese Laid-Open Patent Publication No. 61-238203 published October 23, 1986 discloses an apparatus for manufacturing continuous zigzag coupling elements of thermoplastic resin for slide fasteners from a linear filamentary material. The disclosed apparatus
10 includes a die wheel which is continuously rotated to form the continuous zigzag coupling elements on its circumferential surface. The disclosed apparatus can produce zigzag coupling elements at an increased production rate, but is only capable of manufacturing a single
15 row of zigzag coupling elements at a time.

The present invention seeks to provide an apparatus for manufacturing zigzag coupling elements for slide fasteners at a greatly increased production rate.

According to the present invention, there is provided an apparatus for manufacturing continuous zigzag
20 coupling elements for slide fasteners from continuous linear filaments, comprising: a continuously rotatable drive shaft; a plurality of die wheels fixedly mounted on the drive shaft in juxtaposed relation, each of the

die wheels having respective rows of teeth mounted on circumferential surfaces thereof at a constant pitch, the teeth of one of the rows being displaced half of the pitch with respect to the teeth of another row, the
5 die wheels also having respective forming grooves defined circumferentially in the circumferential surfaces, the teeth of the one row of one of the die wheels being axially aligned with the teeth of the one row of the other die wheel, the teeth of the other row
10 of the one die wheel being axially aligned with the teeth of the other row of the other die wheel; a single filament guide member having a plurality of filament guide holes confronting the circumferential surfaces, respectively, for introducing respective continuous lin-
15 ear filaments; a first drive unit coupled to the filament guide member for reciprocally moving the filament guide holes in the directions of generatrices of the circumferential surfaces; a second drive unit coupled to the filament guide member for reciprocally
20 moving the filament guide holes in the tangential directions of the circumferential surfaces, the second drive unit being operable at a speed which is twice the speed of operation of the first drive unit, the first and second drive units being operable at speeds and distances
25 selected such that the filament guide holes will follow symmetric 8-shaped lemniscate-like paths, respectively, to place the continuous linear filaments continuously

around respective pairs of the teeth as coupling element materials; and means disposed respectively around the die wheels for processing the coupling element materials into the continuous zigzag coupling elements.

5 In a preferred embodiment, the filament guide member extends axially across the die wheels. Since the die wheels are fixed to the common drive shaft, they can continuously rotate in phase with each other. Inasmuch as the filament guide holes for introducing the respective filaments are defined in the
10 single filament guide member, when the filament guide member is actuated by the first and second drive units, the filaments can be supplied onto the circumferential surfaces of the die wheels while following exactly the same paths so that the filaments will be placed around
15 the teeth in the same patterns. The processing means are disposed respectively around the die wheels for producing as many rows of continuous zigzag coupling elements as the number of the die wheels while the die wheels are being continuously rotated.

20 Many other advantages and features of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of
25 example.

Figure 1 is a fragmentary perspective view of an apparatus according to the present invention;

Figure 2 is a vertical cross-sectional view of first and second drive units of the apparatus;

5 Figure 3 is an enlarged cross-sectional view taken along line III - III of Figure 2;

Figure 4A is an enlarged fragmentary front elevational view of a die wheel circumferential surface on which a filamentary coupling element material is
10 placed in a zigzag pattern;

Figure 4B is a cross-sectional view taken along line IV-B - IV-B of Figure 4A;

Figure 5A is an enlarged fragmentary front elevational view of the die wheel circumferential surface on which the coupling element material is pushed in
15 a forming groove defined therein;

Figure 5B is a cross-sectional view taken along line V-B - V-B of Figure 5A;

Figure 6A is an enlarged fragmentary front
20 elevational view of the die wheel circumferential surface on which coupling heads are formed in the forming groove;

Figure 6B is a cross-sectional view taken along line VI-B - VI-B of Figure 6A;

25 Figure 7A is an enlarged fragmentary front elevational view of the die wheel circumferential surface on which rising portions are formed on connectors

of legs of the coupling element material in the forming groove;

Figure 7B is a cross-sectional view taken along line VII-B - VII-B of Figure 7A;

5 Figure 8 is a schematic diagram showing moving patterns of various components of the apparatus;

Figures 9 through 13 are fragmentary views of the die wheel circumferential surface illustrating a process of progressively placing the coupling element material
10 around teeth on the circumferential surface;

Figure 14 is an enlarged fragmentary plan view of the coupling element material;

Figure 15 is an enlarged fragmentary plan view of formed zigzag coupling elements;

15 Figure 16 is an end view of the zigzag coupling elements;

Figure 17 is a front elevational view of a coupling element forming system incorporating the apparatus of the present invention;

20 Figure 18 is a front elevational view of a lifting device;

Figure 19 is a plan view of a bending device;

Figure 20 is a front elevational view of a punching device as viewed in a tangential direction of a
25 die wheel; and

Figure 21 is a plan view of a pressing device.

As shown in Figure 1, an apparatus for

manufacturing continuous zigzag coupling elements for slide fasteners according to the present invention includes a plurality of die wheels (two in the illustrated embodiment) 1a, 1b each having on their circumferential surfaces 2a, 2b two rows 5, 6 of teeth 3, 4 spaced certain intervals or pitches P along the circumferential surface. The teeth 3 of one of the rows 5 are circumferentially displaced or staggered with respect to the teeth 4 of the other row 6 by half of the pitch P.

The die wheels 1a, 1b are fixedly mounted in juxtaposed relation on a single continuously rotatable drive shaft 55 (Figure 17) with the teeth 3, 4 on the die wheel 1a being held in phase with teeth 3, 4 on the die wheel 1b, respectively.

A single filament guide member 8 is positioned across the circumferential surfaces 2a, 2b of the die wheels 1a, 1b in confronting relation thereto, the filament guide member 8 having a pair of filament guide holes 7a, 7b for guiding linear filaments of thermoplastic resin respectively onto the circumferential surfaces 2a, 2b to form zigzag coupling elements.

The filament guide member 8 is connected to a first drive unit 9 for reciprocally moving the filament guide holes 7a, 7b in the directions G of generatrices of the circumferential surfaces 2a, 2b, and a second

drive unit 10 for reciprocally moving the filament guide holes 7a, 7b in tangential directions T of the circumferential surfaces 2a, 2b.

As shown in Figures 2 and 3, the filament guide member 8 comprises an L-shaped guide bar 11 in which the filament guide holes 7a, 7b are defined, an L-shaped joint 12 connected to the guide bar 11, and a guide rod 13 coupled to the joint 12. The guide rod 13 extends from within an apparatus frame through a hole 15 defined in a frame wall 14 of the apparatus frame toward the die wheels 1a, 1b, as shown in Figure 2. The guide rod 13 has a distal end to which the L-shaped joint 12 is fixed by bolts 16 (Figure 3) after it is positionally adjusted axially of the guide rod 13 in the directions of the arrow C.

The L-shaped joint 12 has an arm 17 directed toward the die wheels 1a, 1b. The L-shaped guide bar 11 has an arm 18 disposed in confronting relation to the circumferential surfaces 2a, 2b of the die wheels 1a, 1b, and an arm 19 extending at a right angle from the arm 18. The arm 17 of the joint 12 is fastened to the arm 19 of the L-shaped guide bar 11 by bolts 20 after it is positionally adjusted in the directions of the arrow D to adjust the distance between the arm 18 and the circumferential surfaces 2a, 2b.

The arm 18 is preferably positioned such that the distance between its lower surface 18' and the upper

surfaces of the teeth 3, 4 on the circumferential surfaces 2a, 2b is smaller than the thickness or diameter of a filament 48 (Figure 3).

5 The guide rod 13 is supported by bearings 23 in a hole 22 in a guide block 21 extending through the hole 15 of the frame wall 14 for reciprocating slidable movement in the directions of the arrows E, F. The guide rod 13 has a rear end 24 coupled to a first link 26 by a universal joint 25. The link 26 is coupled to an eccentric pin 28 on a first input shaft 27 which is
10 continuously rotatable by an actuator (not shown) for reciprocating movement in the directions of the arrows E, F.

The first drive unit 9 referred to above is primarily constructed of the guide rod 13, the link 26, and
15 the first input shaft 27.

The guide block 21 is positioned in a crisscross groove composed of a horizontal groove 31 and a vertical groove 32 which are defined in a guide holder 30 fixed
20 to the inner surface of the frame wall 14 by means of bolts 29. The guide block 21 has a projection 33 extending into the vertical groove 32.

To the projection 33, there is pivotally coupled by a pin 35 a universal joint 34 which is joined by an
25 adjustment nut 37 to a second link 36 that is in turn coupled to an eccentric pin 39 on a second input shaft 38. The second input shaft 38 is continuously rotatable

by an actuator (not shown) at a speed which is twice the speed of rotation of the first input shaft 27 for vertically reciprocally moving the guide block 21 in the directions of the arrows I, J.

5 The horizontal groove 31 in which the guide block 21 is housed has a height H, and the hole 15 of the frame wall 14 has a height h. These heights H, h are selected to allow such reciprocating movement of the guide block 21 for a prescribed interval in the direc-
10 tion of the arrows I, J.

Four guide posts 40, arranged in upper and lower pairs, are vertically fixed to the guide block 21 and slidably fitted in respective guide holes 41 in the guide holder 30 through respective bearings 42 for
15 permitting the guide block 21 to be reciprocally movable in the directions of the arrows I, J while keeping a constant posture.

The second drive unit 10 referred to above is mainly composed of the projection 33, the universal
20 joint 34, the second link 36, and the second input shaft 38.

The circumferential surfaces 2a, 2b of the die wheels 1a, 1b have forming grooves 43a, 43b, respectively, defined therein and running
25 circumferentially, as shown in Figures 1, 2, and 3.

The forming grooves 43a, 43b are defined between laterally spaced side walls 44, 45 (Figure 4B) including

partition ridges 46, 47, respectively, positioned in alignment with the respective teeth 3, 4. Adjacent ones of the partition ridges 46, 47 define therebetween a forming die for the filament as described later on.

5 Figure 8 schematically shows paths or moving patterns of the various components shown in Figures 1 and 2. When the first input shaft 27 rotates, the guide rod 13 is reciprocally moved in the directions of the arrows E, F to simultaneously move the filament guide holes 7a, 10 7b reciprocally in distances L in phase with each other. The distance L is the same as the sum of the distance between the outer end surfaces of the teeth 3, 4 between which the filament guide holes 7a, 7b are movable and twice as large as the thickness or diameter of the 15 filament 48.

While the guide rod 13 is being reciprocally moved in the directions of the arrows E, F, the second input shaft 38 is rotated to move the guide block 21 reciprocally in the directions of the arrows I, J for 20 reciprocally moving the filament guide holes 7a, 7b in distances 1. The distance 1 is the same as the distance which is traversed by the filament guide holes 7a, 7b as they move around the opposite side surfaces of the teeth 3, 4. In Figure 8, the teeth 4 are shown as being in 25 phase with, or in axial alignment with, the teeth 3. Actually, while the filament guide holes 7a, 7b are moving around the teeth 3, the die wheel 1 is rotated to move the teeth 3, 4 by one pitch for each one revolution of shaft 27 (and two revolutions of shaft 38),

the teeth 4 lagging a half pitch in phase relative to the teeth 3.

The speed of rotation of the die wheels 1a, 1b, the speed and distance of movement of the first drive unit 9, and the speed and distance of movement of the second drive unit 10 are selected such that the filament guide holes 7a, 7b continuously follow a lemniscate-like path having a symmetric "8" shape around a pair of teeth 3, 4 of the rows 5, 6, as described later on.

10 It is assumed that the filament guide holes 7a, 7b are first positioned intermediate between the teeth 3, 4. Then, when the first and second input shafts 27, 38 are rotated, the eccentric pin 28 moves to a position 28-1 and then to a position 28-2, and the eccentric pin 15 39 moves to a position 39-1 and then to a position 39-2, so that the filament guide holes 7a, 7b simultaneously move to a position 7-1 and then to a position 7-2 in the direction of the arrow K. When the eccentric pin 28 moves to a position 28-3 and then to a position 28-4 and 20 the eccentric pin 39 moves to a position 39-3 and then to a position 39-4, the filament guide holes 7a, 7b move to a position 7-3 and then to a position 7-4 in the direction of the arrow M, thus making a complete revolution around the teeth 3.

25 Likewise, when the eccentric pin 28 moves to a position 28-4 to a position 28-5 and then to a position 28-6, the eccentric pin 39 makes another revolution

through the positions 39-1, 39-2, 39-3, 39-4, during which time the filament guide holes 7a, 7b move around the teeth 4 as indicated by the arrows N, O. The filament guide holes 7a, 7b thus follow the 8-shaped
5 path.

Figures 9 through 13 show the manner in which the linear coupling element forming filament is placed around the teeth 3, 4 on the die wheel 1a by the movement of the filament guide hole 7a along the 8-shaped
10 pattern. Figure 9 shows the relationship between the filament 48 and the teeth 3, 4 on the circumferential surface 2a when the filament guide hole 7a is in the position indicated by 7a. Figure 10 shows the relationship between the filament 48 and the teeth 3, 4 when the
15 filament guide hole 7a is in the position 7-1. Figure 11 shows the relationship between the filament 48 and the teeth 3, 4 when the filament guide hole 7a is in the position 7-2. Figure 12 shows the relationship between the filament 48 and the teeth 3, 4 when the filament
20 guide hole 7a is in the position 7-3. Figure 13 illustrates the relationship between the filament 48 and the teeth 3, 4 when the filament guide hole 7a is in the position 7-4. The filament 48 is placed around the tooth 4 in the same manner as shown in Figures 9 through
25 13 except that the filament 48 moves in the opposite direction. The teeth 3, 4 are continuously moved as shown in Figures 9 through 13 by continuous rotation of

the die wheel 1a.

Since the guide posts 40 on the guide block 21 are slidably fitted in the guide holes 41 in the guide holder 30, the guide block 21 is confined to the
5 reciprocating movement in the directions of the arrows I, J. The guide rod 13 slidably fitted in the hole 22 of the guide block 21 is confined to the reciprocating movement in the directions of the arrows E, F. As a consequence, as shown in Figure 8, the filament guide
10 holes 7a, 7b describe the symmetric 8-shaped lemniscate-like path. The filament guide holes 7a, 7b are not subjected to wobbling movement while they are following the lemniscate-like path, and hence they can reliably place the filament 48 around the teeth 3, 4 in engagement
15 therewith.

The distance between the upper surfaces of the teeth 3, 8 and the lower surface 18' of the arm 18 of the filament guide member 8 is maintained as a predetermined constant distance.

20 Figure 14 shows a filamentary coupling element material 49 which is shaped in the process shown in Figures 9 through 13 by bending the linear filament 48 into a zigzag form.

The filament 48 is made of thermoplastic
25 synthetic resin such as polyester, polyamide, or the like. The shaped coupling element material 49 shown in Figure 14 is then bent into a U shape having coupling

heads 50 and legs 51 which are joined by connectors having rising portions 52 on their outer ends which are formed by application of heat, thus producing zigzag coupling elements 53 as shown in Figures 15 and 16.

5 Figure 17 shows a coupling element forming system 54 for continuously forming the zigzag coupling elements 53 illustrated in Figures 15 and 16. The die wheels 1a, 1b are fixedly mounted in juxtaposed relation on a drive shaft 55 of an actuator (not shown) for continuous rotation in phase with each other in the direction of the
10 arrow Q. The single filament guide member 8 having the filament guide holes 7a, 7b and movable by the first and second drive units 9, 10 is disposed in confronting relation to the circumferential surfaces 2a, 2b of the
15 die wheels 1a, 1b. A lifting device 56 is positioned downstream of the filament guide member 8 in the direction of the arrow Q for lifting the element material 49 off the teeth 3, 4 as indicated by the two-dot-and-dash lines in Figure 5B (which only shows the die wheel 1a).

20 As illustrated in Figure 18, the lifting device 56 has wedge members 75, 76, 77 mounted on the distal ends of arms 72, 73, 74, respectively, supported on and extending from a support shaft 71 mounted on a frame 70. The wedge member 76 is positioned between the die wheels
25 1a, 1b, the wedge member 75 is positioned outside of the die wheel 1a, and the wedge member 77 is positioned outside of the die wheel 1b, for lifting the coupling ele-

ment material 49 out of engagement with the teeth 3, 4 as shown in Figure 5B.

A bending device 57 is positioned just downstream of the lifting device 56 for bending the coupling element materials 49 shaped as shown in Figure 14 into a cross-sectionally U shape by forcing the coupling element materials 49 into the forming grooves 43a, 43b in the die wheels 1a, 1b. As illustrated in Figures 5B and 19, the bending device 57 comprises discs 58a, 58b rotatable by contact with the respective die wheels 1a, 1b and having circular bending blades 59a, 59b, respectively, disposed on and extending radially outwardly from the circumferential surfaces of the discs 58a, 58b for entering the respective forming grooves 43a, 43b of the die wheels 1a, 1b. Therefore, the coupling element materials 49 are continuously bent into the U shape by the bending blades 59a, 59b as they force the coupling materials 49 into the forming grooves 43a, 43b, as shown in Figure 5B.

In Figure 19, the bending blades 59a, 59b can be positionally adjusted for exact alignment with the forming grooves 43a, 43b by means of adjustment bolts 78, 79.

As shown in Figure 17, a heating device 60 is disposed downstream of the bending device 56 in the direction of the arrow Q in partly surrounding relation to the circumferential surfaces 2a, 2b of the die wheels

1a, 1b for heating the U-shaped coupling element materials 49 up to a set point of the thermoplastic synthetic resin thereof.

A punching device 61 is positioned downstream of the heating device 60 in the direction of the arrow Q. The punching device 60 has punches 62a, 62b (Figures 6B and 20) for entering the forming grooves 43a, 43b of the die wheels 1a, 1b. As shown in Figure 6B, the punches 62a, 62b as they enter the forming grooves 43a, 43b press the coupling element materials 49 against the bottoms 63 of the forming grooves 43a, 43b to form the coupling heads 50.

Figure 20 shows the punching device 61 as viewed tangentially to the circumferential surfaces 2a, 2b of the die wheels 1a, 1b. The punches 62a, 62b are fixed by a bolt 82 to a sleeve 81 fitted eccentrically over a shaft 80. The shaft 80 is rotated by an actuator (not shown) to move the punches 62a, 62b along a path R (Figure 17) for repeatedly pressing the punches 62a, 62b against the coupling element materials 49 to form the coupling heads 50 and retracting the punches 62a, 62b while the die wheels 1a, 1b are continuously being rotated.

A pressing device 64 is located downstream of the punching device 61 in the direction of the arrow Q. As illustrated in Figures 17 and 21, the pressing device 64 comprises discs 65a, 65b rotatable by contact with the

die wheels 1a, 1b, respectively, and having respective guide flanges 67a, 67b disposed on respective circumferential surfaces 66a, 66b of the discs 65a, 65b for entering the forming grooves 43a, 43b, respectively.

5 The circumferential surfaces 66a, 66b of the discs 65a, 65b press the connectors of the legs 51 against the circumferential surfaces 2a, 2b of the die wheels 1a, 1b to form the rising portions 52 (Figures 15, 16, 7B) on the outer ends of the connectors.

10 The discs 65a, 65b can be positionally adjusted by adjustment bolts 83, 84, 85 for exact alignment with the forming grooves 43a, 43b. The discs 65a, 65b are fixed by a bolt 87 to a shaft which is rotatably supported in a bearing 86.

15 A cooling device 68 is disposed downstream of the pressing device 64 in the direction of the arrow Q in surrounding relation to the circumferential surfaces 2a, 2b of the die wheels 1a, 1b for cooling the coupling element materials 49 which have been shaped as described
20 above and setting them to the two rows of zigzag coupling elements 53.

The formed two rows of the zigzag coupling elements 53 are removed from the die wheels 1a, 1b by a discharging device 69.

25 The first and second drive units 9, 10 employ eccentric mechanisms, but may comprise cam mechanisms instead of the eccentric mechanisms. The guide rod 13

is shown as being slidably guided in a sleeve portion of the guide block 21, but may be guided in the guide block 21 by a dovetail/groove guide mechanism.

The two die wheels 1a, 1b have been described in the aforesaid embodiment. However, three or more die wheels may be employed, and hence various other devices associated with the die wheels may have three or more sets of components for coaction with the die wheels.

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Claims:-

1. An apparatus for manufacturing continuous zigzag coupling elements for slide fasteners from continuous linear filaments, comprising:

a continuously rotatable drive shaft;

5 a plurality of die wheels fixedly
mounted on said drive shaft in juxtaposed relation, each
of said die wheels having respective rows of teeth
mounted on circumferential surfaces thereof at a constant pitch, said teeth of one of the rows being
10 displaced half of said pitch with respect to said teeth
of another row, said die wheels also having respective
forming grooves defined circumferentially in said
circumferential surfaces, said teeth of said one row of
one of said die wheels being axially aligned with said
15 teeth of said one row of the other die wheel, said teeth
of said other row of said one die wheel being axially
aligned with said teeth of said other row of said other
die wheel;

a single filament guide member having a plurality
20 of filament guide holes confronting said circumferential
surfaces, respectively, for introducing respective continuous linear filaments;

a first drive unit coupled to said filament guide
member for reciprocally moving said filament guide holes
25 in the directions of generatrices of said
circumferential surfaces;



a second drive unit coupled to said filament guide member for reciprocally moving said filament guide holes in the tangential directions of said circumferential surfaces, said second drive unit being
5 operable at a speed which is twice the speed of operation of said first drive unit, said first and second drive units being operable at speeds and distances selected such that said filament guide holes will follow symmetric 8-shaped lemniscate-like paths, respectively,
10 to place the continuous linear filaments continuously around respective pairs of said teeth as coupling element materials; and

means disposed respectively around said die wheels for processing the coupling element materials
15 into the continuous zigzag coupling elements.

2. An apparatus according to claim 1, said filament guide member extending axially across said die wheels.