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APPARATUS FOR FORMING A ROW OF
ZIGZAG COUPLING ELEMENTS FOR SLIDE FASTENERS

The present invention relates generally to the manufacture of slide fastener, and more particularly to an apparatus for forming a row of continuous zigzag coupling elements for a slide fastener from a filament
5 of thermoplastic material.

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published on July 19, 1950 discloses an apparatus of the type described which comprises a heated die wheel having two rows of circumferentially staggered pins
10 disposed one on each side of a central groove in the die wheel, and a series of working units disposed along the periphery of the die wheel for forming a row of continuous zigzag coupling elements from a thermoplastic synthetic resin monofilament while the
15 latter is carried on the die wheel. Such working units are disposed between a winding unit for winding the monofilament around the pins in a zigzag form and a

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discharge unit for removing the formed coupling elements successivley from the die wheel, and have respective working heads projectable into the groove to deform the monofilament into predetermined shapes.

5 Since the die wheel has a diameter much larger than the width of the groove, the groove is neccesarily displaced slightly in the lateral direction when the die wheel is rotated, due to manufacturing tolarences in the die wheel. The disclosed apparatus has no means for accomodating or
10 taking up such lateral oscillation of the groove with the result that the working heads are brought out of accurate registry with the groove. The monofilament is liable to be unduly deformed or damaged by the working heads projecting into such oscillating groove. The
15 coupling elements formed from such damaged filament cannot be used in effect for a slide fastener.

It is believed possible by means of the present invention to provide an apparatus which can form a row of continuous zigzag coupling elements reliably with
20 accuracy.

It is further believed possible by means of the present invention to provide an apparatus having means for accodocating lateral oscillation of a rotating die wheel on which a filament of thermoplastic material is
25 deformed into a row of zigzag coupling elements by means of working heads projecting into and movable in harmony with a groove in the periphery of the oscillating die wheel.

According to the present invention, there is provided an apparatus for forming a row of continuous zigzag coupling elements from a filament of thermoplastic material, comprising a frame; a heated die wheel mounted on said frame and having a groove in its peripheral surface, and a pair of rows of circumferentially staggered pins disposed one on each side of said groove; a winding unit for winding the filament alternately around said pins across said groove in a zigzag form; a lifting unit for lifting up the zigzag filament away from said pins; a bending unit for pushing the lifted zigzag filament into said groove to form a row of zigzag coupling elements having parallel legs interconnected at one end by first connecting portions; a punching unit for punching each of the connecting portions to form a coupling head; and a discharging unit for removing formed coupling elements from said die wheel, all said units being disposed around the peripheral surface of said die wheel in the described order, each of said bending and punching units having a working head projectable into said groove, characterized in that said working head is movable in a direction parallel to the axis of said die wheel.

25 The invention will be described by way of example with reference to the accompanying drawings, wherein:-

Figure 1 is a schematic front elevational view of an apparatus embodying the present invention for forming a row of zigzag coupling elements;

5 Figure 2 is an enlarged side elevational view of a portion encircled by dots-and-dashes line II of Figure 1;

Figure 3 is a fragmentary cross-sectional view taken along line III - III of Figure 2;

10 Figure 4 is an enlarged side elevational view, partly in cross section, of a bending unit of the apparatus shown in Figure 1;

Figure 5 is an enlarged view of a portion encircled by dots-and-dashes line V of Figure 4;

15 Figure 6 is an enlarged front elevational view, partly in cross-section, of a punching unit of the apparatus shown in Figure 1;

Figure 7 is a cross-sectional view taken along line VII - VII of Figure 6;

20 Figure 8 is an exploded perspective view of a punch and a presser pad of the punching unit;

Figure 9 is an enlarged view of a portion encircled by dots-and-dashes line IX of Figure 7;

Figure 10 is an enlarged front elevational view

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of a hammering unit of the apparatus shown in Figure 1;

Figure 11 is a cross-sectional view taken along line XI- XI of Figure 10; and

Figure 12 is an enlarged view of a portion
5 encircled by dots-and-dashes line XII of Figure 11.

As shown in Figure 1, an apparatus 20 for forming a row of continuous zigzag coupling elements for slide fasteners, comprises a frame 21, and a die wheel 22 fixed to a shaft 23 rotatably mounted on the
10 frame 21 and driven by a suitable drive means (not shown) to rotate the die wheel 22 intermittently in the clockwise direction. The die wheel 22 has two rows of circumferentially staggered pins 24, 24 disposed one on each side of a central groove 25 in the die wheel 22,
15 as shown in Figures 2 and 3.

The apparatus 20 further includes a winding unit 26 for winding a filament a of thermoplastic material, such as a thermoplastic synthetic resin monofilament, alternately around the pins 24 across the groove 25 in
20 a zigzag form (Figure 2), a lifting unit 27 for lifting up the zigzag filament b away from the pins 24, a bending unit 28 for pushing the lifted zigzag filament b into the central groove 25 to form a row of zigzag coupling elements c having parallel legs d
25 interconnected at their lower ends by lower connecting portions (Figure 5), a punching unit 29 for punching each connecting portion to form a coupling head e

having a pair of lateral projections (Figure 9), a hammering unit 30 for bending upper end portions of the parallel legs d laterally outwardly away from each other to form raised connecting portions f, f interconnecting adjacent coupling elements c (Figure 12), and a discharging unit 31 for removing formed coupling elements g from the die wheel 22, all units 26 - 31 being mounted on the frame 21 and disposed clockwise around the die wheel 22 in the described order, as shown in Figure 1. The die wheel 22 is heated by a suitable heating means such as an induction heating unit (not shown) to soften the thermoplastic filament a as the latter is processed on the die wheel 22. A detector 32 is also disposed on the frame 21 between the punching unit 29 and the pressing unit 30 for detecting a trailing end of the filament a to stop operation of the apparatus 20.

The hammering unit 31 may be omitted or kept deactivated when the filament a is formed into a row of zigzag coupling elements of the type having connecting portions extending in the same plane as the corresponding legs d, d.

The winding unit 26 includes a guide member 33 movable back and forth in the axial direction of the die wheel 22 across the central groove 25 and having a guide hole 34 for the passage therethrough of the filament a. In operation, the filament a is supplied

from a bobbin (not shown) in the apparatus 20, in which the filament a passes through the guide hole 34. By moving the guide member 33 back and forth in a direction parallel to the axis of the die wheel 22 while the latter is being intermittently rotated clockwise as shown in Figure 1, the filament a is caused to extend alternately around the pins 24 across the central groove 25 as shown in Figure 2.

As shown in Figure 4, the bending unit 28 includes a tubular arm 35 fixed to the frame 21 and extending parallel to the axis of the die wheel 22, and a flanged holder 36 slidably rotatably received in the tubular arm 35 and having an eccentric bore 37 extending longitudinally therethrough. A bending roller 38 has a central shaft 39 extending through the bore 37 and rotatably mounted on the holder 36 via a pair of spaced needle bearings 40, 40 fitted in the bore 37. An annular disc 41 is supported on the roller 38 and has a peripheral edge portion 41a projecting from the periphery of the bending roll 38 and received in the central groove 25 in the die wheel 22, the peripheral portion 41a serving as a working head. The bending roller 38 and the annular disc 41 may be formed integrally with each other. A stop ring 42 is fixedly mounted on an end of the shaft 39 projecting from a flange 43 of the holder 34 remotely from the bending roller 38. A U-shaped spacer 44 is mounted on the

shaft 39 between the stop ring 42 and the holder's flange 43, there being defined an annular clearance 45 between the stop ring 42 and the spacer 44. The amount of the clearance 45 can be varied by replacing the
5 spacer 44 with another U-shaped spacer 46 having a different thickness. A lock bolt 47 is threaded radially into the arm 35 to fix the holder 36 in position to the arm 35. With the rock bolt 47 being loosed, the holder 36 is allowed to rotate in the arm
10 35 as well as to move axially in the arm 35. Due to the eccentric bore 37 in the holder 36, rotation of the holder 36 causes to vary a distance between the central axis of the bending roller 38 and the bottom of the central groove 25. By moving the holder 36 in the
15 axial direction, the peripheral portion or working head 41a of the annular disc 41 can be positioned accurately in registry with the central groove 25 in the die wheel 22. The amount of axial movement to the holder 36 is changed by means of an adjusting bolt 48 threaded
20 through the holder's flange 43 into abutting engagement with an end surface of the arm 35.

With this arrangement, the working head 41a is adjustable in both depthwise and widthwise directions of the central groove 25. Furthermore, with the
25 clearance 45 provided between the stop ring 42 and the spacer 44, the shaft 39 is axially slidable and hence the working head 41a is movable in the widthwise

direction of the central groove 25 to accomodate lateral oscillation of opposed sidewalls of the central groove 25 while the die wheel 22 is being rotated.

Thus, the zigzag filament a can be bent into a row of
5 zigzag coupling elements c including parallel legs d, d having the same length as shown in Figure 5.

As shown in Figure 6 to 9, the punching unit 29 includes a rocking lever 49 supported at one end by a shaft 50 journaled on the frame 20 (Figure 1) and
10 driven by a suitable drive means (not shown) to angularly move the rocking lever 49 toward and away from the die wheel 22. The rocking lever 49 supports on its free end a punch holder 51 in the shape of a rectangular hollow box with one side open and having a
15 guide groove 52 in which a punch 53 is received. The punch 53 is generally in the shape of a rectangular plate and has at a lower end a working head 54 extending in registry with the central groove 25 in the die wheel 22. The punch 53 further has a pair of
20 lateral recesses 55, 55 opening away from each other for respectively receiving therein a pair of projections 56, 56 on a presser pad 57. The presser pad 57 has a pair of oblong through-holes 58, 58 located in registry with the respective projections 56,
25 56 and extending in a direction parallel to the longitudinal axis of the punch 53. The punch 53 is mounted on the punch holder 51 by securing together the

presser pad 57 and the punch holder 53 by means of a screws 59 extending loosely through the oblong through-holes 58 and corresponding oblong through-holes 60 in the punch holder 51, and nuts 61 threaded on the screws 59, while the projections 56 on the presser pad 57 is received in the recesses 55. The punch 53 thus mounted is positionally adjustable in the longitudinal direction thereof. An adjusting bolt 62 is threaded through the punch holder 51 into the groove 52 and abuts against an upper end of the punch 53 to adjust the distance between the working head 54 and the central groove 25. As the projections 56 have a height T larger than the thickness t of the punch 53 as shown in Figure 8, a clearance 63 is defined between the punch holder 51 and the punch 53 mounted thereon as shown in Figure 7. The punch 53 is slidably movable on the projections 56 as the working head 54 is moved in the groove 25 in the widthwise direction thereof in agreement with the lateral oscillation of the groove 25. With this arrangement, a coupling head e is formed on a lower connecting portion of each coupling element c at accurate position as shown in Figure 8.

As shown in Figures 10 to 12, the hammering unit 30 includes a rocking arm 64 supported at one end by a shaft 65 journaled on the frame 20 (FIG, 1) and driven by a suitable drive means (not shown) to angularly move the rocking lever 64 toward and away from the die wheel

22. The rocking arm 64 supports on its free end a hammer holder 66 in the shape of a substantially hollow rectangular box having a longitudinal guide groove 67 in which a hammer 68 is received. The hammer 68 is in the form of a rectangular plate and has a maximum thickness t' which is smaller than the depth T' of the groove 67 so that there is defined a clearance 69 between the hammer 68 and the hammer holder 66, as shown in Figure 11. The hammer 68 has at opposite ends a locking portion 70 in the form of an upwardly directed hook and a working or hammering head 71 extending in registry with the central groove 25 in the die wheel 22. As shown in Figure 12, the hammering head 71 is composed of a central projection 71a and a pair of lateral shoulders 71b, 71b disposed one on each side of the projection 71a. The hammering head 71 has a maximum thickness larger than the width of the central groove 25 in the die wheel 22. A hammer support 72 is received in the groove 67 and has a locking end portion 73 in the form of a downwardly directed hook and held in locking engagement with the hook-shaped locking portion 70 of the hammer 68 with clearances 74 therebetween. The clearances 74 have a width substantially the same as or slightly larger than the width of the clearance 69. The hammer support 72 has an oblong through-hole 75 extending in a direction parallel to the longitudinal axis of the hammer 68. A



lock bolt 77 extends loosely through the oblong through-hole 76 and is threaded into the hammer holder 66 to thereby mount the hammer 68 on the holder 66. An adjusting bolt 77 is threaded through the hammer holder 5 66 and abuts against an end of the hammer support 72 remotely from the hook-shaped locking end portion 73 to adjust the distance between the hammering head 71 and the central groove 25 within the length of the oblong through-hole 75. With the clearance 69 defined between 10 the holder 64 and the hammer 68, the working head 71 is movable to follow lateral oscillation of the central groove 25 in the die wheel 22 as the latter is rotated. The zigzag coupling elements c (Figure 12) is forced by the working head 71 to bend at upper portions of the 15 respective legs d, d outwardly away from each other to form the raised connecting portions f, f having the same height.

As shown in Figure 1, the discharging unit 31 includes a tapered scraper 78 having a tip end (not 20 shown) loosely received in the central groove 25 for removing the formed coupling elements g successively from the die wheel 21 as the latter is rotated. A nozzle 79 is disposed adjacent to the scraper 78 in confronting relation to the tip end, and ejects a 25 cooling medium such as cold air for cooling the formed coupling elements g to set.

With the apparatus 20 thus constructed, the

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filament a is deformed reliably and accurately into the zigzag coupling elements g successively by the bending unit 28, punching unit 29, and the hammering unit 30 each having the working head 41a, 54, 71 which is
5 allowed to move in harmony with the lateral oscillation of the groove 25 in the die wheel 22.

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Claims:-

1. An apparatus for forming a row of continuous zigzag coupling elements from a filament of thermoplastic material, comprising:

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(a) a frame;

(b) a heated die wheel mounted on said frame and having a groove in its peripheral surface, and a pair of rows of circumferentially staggered pins disposed one on each side of said groove;

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(c) a winding unit for winding the filament alternately around said pins across said groove in a zigzag form;

(d) a lifting unit for lifting up the zigzag filament away from said pins;

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(e) a bending unit for pushing the lifted zigzag filament into said groove to form a row of zigzag coupling elements having parallel legs interconnected at one end by first connecting portions;

(f) a punching unit for punching each of the
20 connecting portions to form a coupling head;

(g) a discharging unit for removing formed coupling elements from said die wheel, all said units being disposed along the peripheral surface of said die wheel in the described order; and

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(h) each of said bending and punching units having a working head projectable into said groove and movable in a direction parallel to the axis of said die wheel.

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2. An apparatus according to claim 1, each of said bending and punching units having a holder, and a working member having at one end thereof said working head, said working member being slidably movably supported on said holder with a clearance therebetween, said clearance extending in a direction perpendicular to the axis of said die wheel.

3. An apparatus according to claim 1 or 2, said bending unit including a tubular arm fixed to said frame, a holder slidably rotatably mounted in said tubular arm and having a longitudinal bore, a bending roller having said working head on its periphery and a central shaft journaled on said holder, said shaft extending through said bore and having a portion projecting beyond one end of said holder, and a stop ring releasably mounted on said portion of said shaft, there being defining between said stop ring and said one end of said holder a clearance extending in a direction perpendicular to the axis of said die wheel.

4. An apparatus according to claim 3, including a spacer ring mounted on said shaft between said stop ring and said one end of said holder.

5. An apparatus according to claim 3 or 4, said bore being eccentric to the longitudinal central axis of said tubular arm.

6. An apparatus according to claim 3, 4 or 5, said holder including a flange extending radially outwardly from said one end of said holder, an adjusting bolt



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extending through said flange into abutment with one end of said tubular arm.

7. An apparatus according to any preceding claim said punching unit including a rocking lever pivotably supported on said frame and rockingly movable toward and away from said die wheel, a punch holder mounted on a free end of said rocking lever and having a guide groove extending perpendicularly to the axis of said die wheel, a substantially rectangular punch received in said guide groove and having said working head at one end thereof and a pair of lateral recesses adjacent to the other end, and a presser pad secured to said holder and having a pair of projections receivable in said recesses, respectively, said projections having a height larger than the thickness of said punch, there being defined between said punch and said holder a clearance extending in a direction perpendicular to the axis of said die wheel.

8. An apparatus according to claim 7, said presser pad including an oblong through-hole disposed in registry with each said projection and extending in the longitudinal direction of said punch, a threaded fastener extending through said oblong through-hole.

9. An apparatus according to any preceding claim including a hammering unit disposed between said punching unit and said discharging unit for hammering respective portions of the parallel legs to form raised second connecting portions interconnecting adjacent coupling elements remotely from



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said first connecting portions, said hammering unit having a working head projectable into said groove and movable in a direction parallel to the axis of said die wheel.

5 10. An apparatus according to claim 9, said hammering unit having a holder, and a working member having at one end thereof said working head, said working member being slidably movably supported on said holder with a clearance therebetween, said clearance extending
10 in a direction perpendicular to the axis of said die wheel.

 11. An apparatus according to claim 9 or 10 said hammering unit including a rocking arm pivotably supported on said frame and rockingly movable toward and away from said die wheel, a hammer holder mounted on a free end of
15 said rocking arm and having a guide groove extending perpendicularly to the axis of said die wheel, a substantially rectangular hammer received in said guide groove and having at opposite ends said working head and a hook-shaped locking portion, and a hammer support received
20 in said last-named guide groove and secured to said holder, said support having a hook-shaped end portion held in locking engagement with said hook-shaped locking portion, said groove having a depth larger than the thickness of said hammer, there being defined between said hammer and
25 said hammer holder a clearance extending in a direction perpendicular to the axis of said die wheel.

 12. An apparatus according to claim 11, said support including an oblong through-hole extending in the



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longitudinal direction of said hammer, a threaded fastener
extending through said last-named oblong through-hole.
