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(54) A METHOD AND APPARATUS FOR REMOVING INTERLOCKING FASTENER ELEMENTS FROM A SLIDE FASTENER CHAIN

(71) We, YOSHIDA KOGYO KABUSHIKI KAISHA, a corporation duly organized under the laws of Japan and existing at No. 1, Kanda Izumi-cho, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the provision of a slide fastener stringer which has end portions devoid of interlocking fastener elements, more particularly to a method and apparatus for removing fastener elements at predetermined intervals from a slide fastener chain of substantially endless length thereby providing therein alternate element-containing and element-free sections.

To simplify and facilitate the assembling and finishing of slide fasteners, it is nowadays the common practice of the slide fastener manufacturers to work on a continuous chain of slide fastener stringers carrying thereon uninterrupted, interengaged rows of interlocking elements rather than on separated individual fastener stringers. It has been the usual practice to provide element-free of "space" sections in the fastener chain at predetermined intervals thereon for mounting sliders and end stops and thereafter to cut the chain into individual product length.

There have been proposed various methods and apparatus to this end for removing a length of interlocking elements from a slide fastener chain, but none of them have been found completely satisfactory because the elements were removed forcibly from their carrier tapes to which they are firmly secured. Difficulties have been experienced in cutting the elements off exactly at those portions which are coupled together, and failing this would often cause damage to the woven or sewn threads or even the tape web. This was more critical in the case of a fastener chain carrying rows of continuous fastener elements in a coil or meandering form having reinforcing cords inserted between or braids laid over

elements, where such cords or braids are susceptible to damage in contact with the cutter blades. If the elements were cut not completely off or not at the proper position, it would render the subsequent removal of element debris so much difficult. These difficulties have been a bottleneck to automation of the space-forming operation.

With a view to eliminating the above difficulties encountered with the conventional methods and apparatus, the present invention has for its object to provide an improved method for removing a desired length of interlocking fastener elements from a continuous slide fastener chain without any damage to the woven or sewn threads, reinforcing cords, braids or the like which are used to secure the elements to the carrier tapes and which are hereinafter collectively referred to as element securing members, and an apparatus for effectively carrying this method into practice.

It is a more specific object of the invention to provide an improved method and apparatus for removal of a length of fastener elements which ensures that the elements to be removed are held in correct position relative to the path of a cutting or severing means so as to cut them off exactly at those portions which are coupled together and further that the removal of the remaining portions or debris of the elements is effected with utmost ease, resulting in the provision of clean element-free or "space" sections as desired on the fastener chain.

It is another specific object of the invention to provide an improved space-forming apparatus incorporating the operating parts which are arranged to function in accurate cooperating relation such that the space-forming operation is rendered fully automatic and hence at increased rate of speed.

It is still another specific object of the invention to provide an improved space-forming method and apparatus which incorporates means for gripping the fastener elements exactly at their arm portions and retaining the same in position against displacement during the severing of their coupling heads so that the elements may be cut

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off precisely at their interengaged head portions.

According to the present invention there is provided a method of removing a length of faster elements from a slide fastener chain consisting of a pair of opposed stringer tapes carrying thereon, uninterrupted rows of continuous fastener elements in interlocked relation, element-securing members affixing said rows of elements to the respective tapes, each of said elements having a coupling head, two arm portions and connecting portions merging into adjoining elements, which method comprises:

- a) splitting open the fastener chain along the abutting inner longitudinal edges of the two opposed stringer tapes;
- b) anchoring the coupling head portions of a length of interlocked elements into a position registering with the path of a severing means;
- c) loosely gripping the connecting portions of said length of elements;
- d) biasing the element-securing members inwardly along the arm portions of said length of elements thereby to expose the latter portions;
- e) firmly gripping the thus exposed arm portions so as to retain said length of elements in position against displacement;
- f) severing the interlocked coupling head portions of said length of elements; and
- g) pulling said arm portions, while being gripped, outwardly apart from their respective tapes to remove the remaining element debris.

These and other objects and features of the invention will appear clear from the following detailed description taken in conjunction with the accompanying drawings which illustrate by way of example a preferred embodiment and in which like reference characters refer to like parts throughout the several views.

Figure 1 is a plan view of a segment of a slide fastener chain provided with an element-free or "space" section in accordance with the invention;

Figure 2 is a plan view of a space-forming apparatus embodying the invention;

Figure 3 is a front elevation, partly broken away, of the apparatus of Figure 2;

Figure 4 is a cross-sectional view taken along the line IV-IV of Figure 2; and

Figure 5a through 5h inclusive are sectional elevations of the operating parts of the apparatus of Figure 2 (Figure 3) and are utilized to illustrate the different operating phases that the apparatus assumes during the removal of fastener elements.

Referring now to the drawings and Figure 1 in particular, there is shown a segment of a slide fastener chain F which consists of a

pair of opposed stringer tapes T each carrying along their respective inner edges a row of interlocking fastener elements E. More specifically, the fastener chain F is provided with a predetermined length of an element-free or "space" sections G alternating with an element-containing sections Es. This element-free section is utilized for the assembling of a slider and end stops on the fastener chain F in the well known manner.

The provision of the element-free or "space" section G is effected by the apparatus which is shown by way of example only in the drawings and which is tailored to carry the above-described method into practice.

Referring to Figs. 2 through 4, there is shown a space-forming apparatus 10 which comprises a supporting table 11 on which are mounted the various operating parts including a guiding means 12 for guiding a slide fastener chain F thereon during the movement of the latter to a space-forming station, an element severing means 13 for severing a length of fastener elements E, and an element-debris removing means 14 for removing residual debris of fastener elements E resulting from the severing thereof.

The guiding means 12 comprises a pair of guide blocks 15a, 15b disposed on opposite sides of the space-forming station defined at the element severing means 13. Each guide block includes a pressure pad 17 having downwardly projecting abutments 18 extending longitudinally in parallel with the path of the fastener chain F and defining therebetween an element guide channel 19, and a supporting block 20 underlying the pressure pad 17 and having a vertically extending guide slot 21 and a splitting member 22 accommodated therein and adapted with its tip end 22a to intrude between and split open the opposed inner edges of the two stringer tapes T along which are secured the rows of fastener elements E. The guiding means 12 thus constructed serves to hold the fastener chain F flat in correct horizontal alignment between the oppositely disposed guide blocks 15a, 15b when the chain F is advanced intermittently by a feeding and positioning means (not shown) onto the space-forming station prior to the activation of the severing means 13 and the element-debris removing means 14. The fastener chain F is fed with its back side down, viz. its front side carrying the elements E facing the pressure pad 17 and is held in sandwiched relation between the pressure pad 17, splitting member 22 and supporting block 20.

The severing means 13 comprises a punch carrying anvil 23 and a die block 24 that are disposed in vertically opposed relation as best shown in Fig. 3. The anvil 23 has

rides onto a second cam face 44b greater in height than the first cam face 44a, whereupon the upper jaw 36 is brought into more intimate contact with the fastener elements E so that the claws 38 on both upper and lower jaws bite into the upper and lower arm portions Eb thereby firmly gripping the fastener elements E within the space-forming station and thus retaining the same in position against displacement during the subsequent element severing operation, as shown in Fig. 5e. The sixth phase now begins with the upward stroke of the punch 25, when its bladed top edges 25a cut the interengaged coupling head portions Ea of the fastener elements E and take them away into the die slot 31 as seen in Fig. 5f. Upon completion of this severing operation, the first sector gear 41 is arranged to rotate in the opposite direction so that the grippers 35a, 35b associated therewith are now retracted outwardly away from each other, taking with them all of the remaining element debris including arm portions Eb and connecting portions Ec, apart from the element-securing members that have secured the elements E to the tapes T, as shown in Fig. 5g. This constitutes the seventh phase of the operating cycle which includes reverse rotation of the second sector gear 46 to release the cam roll 43 from the cam faces 44b and 44a respectively so that the upper jaw 36 moves upwardly apart from the element debris, causing the latter to drop. Simultaneously with this, the eighth or final phase of the cycle takes place wherein the die block 24 and the punch 25 are moved vertically away from each other and retracted to their respective initial positions. The respective positions that the severing means 13 and element-debris removing means 14 assume upon completion of the space-forming cycle are illustrated in Fig. 5h which figure corresponds to Fig. 5a, wherein these operating parts are on stand-by to repeat the above cycle of operation when the next section of the fastener chain F is advanced into the space-forming station.

There may be provided air nozzles or suction devices to ensure complete removal of the residual debris of fastener elements E from the space-forming station in the apparatus 10.

Having thus described the invention, it will be understood that various changes or modifications may be made in the specific form and construction herein advanced, without departing from the scope of the appended claims. As for an example, the operating positions of the die and punch may be exchange so that the punch is located above the die. As for another, the gripper actuating means including the sector gears and racks may be substituted by suitable cam, lever or link mechanisms. In addition,

the type of slide fasteners to which the principles of the invention can be applied may be a so-called "woven" fastener other than such fastener illustrated herein which has rows of interlocking elements secured by sewing threads to their respective stringer tapes.

WHAT WE CLAIM IS:—

1. A method of removing a length of fastener elements from a slide fastener chain consisting of a pair of opposed stringer tapes carrying thereon uninterrupted rows of continuous fastener elements in interlocked relation, element-securing members affixing said rows of elements to the respective tapes, each of said elements having a coupling head, two arm portions and connecting portions merging into adjoining elements, which method comprises
 - a) splitting open the fastener chain along the abutting inner longitudinal edges of the two opposed stringer tapes;
 - b) anchoring the coupling head portions of a length of interlocked elements into a position registering with the path of a severing means;
 - c) loosely gripping the connecting portions of said length of elements;
 - d) biasing the element-securing members inwardly along the arm portions of said length of elements thereby to expose the latter portions;
 - e) firmly gripping the thus exposed arm portions so as to retain said length of elements in position against displacement;
 - f) severing the interlocked coupling head portions of said length of elements; and
 - g) pulling said arm portions, while being gripped, outwardly apart from their respective tapes to remove the remaining element debris.
2. An apparatus for removing fastener elements from a slide fastener chain in accordance with the method claimed in Claim 1, comprising a severing means including a vertically movable cutting punch and coacting die for severing a length of fastener elements, said severing means being disposed vertically relative to the plane of the fastener chain, and being adapted to anchor the coupling head portions, an element-debris removing means including a pair of grippers for removing residual debris of fastener elements resulting from the severing thereof, said removing means being horizontally disposed in criss-cross relation to said severing means, an actuating means for moving said pair of grippers horizontally towards and away from each other, a splitting means for splitting open the abutting inner edges of the opposed stringer tapes,

rides onto a second cam face 44b greater in height than the first cam face 44a, whereupon the upper jaw 36 is brought into more intimate contact with the fastener elements E so that the claws 38 on both upper and lower jaws bite into the upper and lower arm portions Eb thereby firmly gripping the fastener elements E within the space-forming station and thus retaining the same in position against displacement during the subsequent element severing operation, as shown in Fig. 5e. The sixth phase now begins with the upward stroke of the punch 25, when its bladed top edges 25a cut the interengaged coupling head portions Ea of the fastener elements E and take them away into the die slot 31 as seen in Fig. 5f. Upon completion of this severing operation, the first sector gear 41 is arranged to rotate in the opposite direction so that the grippers 35a, 35b associated therewith are now retracted outwardly away from each other, taking with them all of the remaining element debris including arm portions Eb and connecting portions Ec, apart from the element-securing members that have secured the elements E to the tapes T, as shown in Fig. 5g. This constitutes the seventh phase of the operating cycle which includes reverse rotation of the second sector gear 46 to release the cam roll 43 from the cam faces 44b and 44a respectively so that the upper jaw 36 moves upwardly apart from the element debris, causing the latter to drop. Simultaneously with this, the eighth or final phase of the cycle takes place wherein the die block 24 and the punch 25 are moved vertically away from each other and retracted to their respective initial positions. The respective positions that the severing means 13 and element-debris removing means 14 assume upon completion of the space-forming cycle are illustrated in Fig. 5h which figure corresponds to Fig. 5a, wherein these operating parts are on stand-by to repeat the above cycle of operation when the next section of the fastener chain F is advanced into the space-forming station.

There may be provided air nozzles or suction devices to ensure complete removal of the residual debris of fastener elements E from the space-forming station in the apparatus 10.

Having thus described the invention, it will be understood that various changes or modifications may be made in the specific form and construction herein advanced, without departing from the scope of the appended claims. As for an example, the operating positions of the die and punch may be exchange so that the punch is located above the die. As for another, the gripper actuating means including the sector gears and racks may be substituted by suitable cam, lever or link mechanisms. In addition,

the type of slide fasteners to which the principles of the invention can be applied may be a so-called "woven" fastener other than such fastener illustrated herein which has rows of interlocking elements secured by sewing threads to their respective stringer tapes.

WHAT WE CLAIM IS:—

1. A method of removing a length of fastener elements from a slide fastener chain consisting of a pair of opposed stringer tapes carrying thereon uninterrupted rows of continuous fastener elements in interlocked relation, element-securing members affixing said rows of elements to the respective tapes, each of said elements having a coupling head, two arm portions and connecting portions merging into adjoining elements, which method comprises

- a) splitting open the fastener chain along the abutting inner longitudinal edges of the two opposed stringer tapes;
- b) anchoring the coupling head portions of a length of interlocked elements into a position registering with the path of a severing means;
- c) loosely gripping the connecting portions of said length of elements;
- d) biasing the element-securing members inwardly along the arm portions of said length of elements thereby to expose the latter portions;
- e) firmly gripping the thus exposed arm portions so as to retain said length of elements in position against displacement;
- f) severing the interlocked coupling head portions of said length of elements; and
- g) pulling said arm portions, while being gripped, outwardly apart from their respective tapes to remove the remaining element debris.

2. An apparatus for removing fastener elements from a slide fastener chain in accordance with the method claimed in Claim 1, comprising a severing means including a vertically movable cutting punch and coacting die for severing a length of fastener elements, said severing means being disposed vertically relative to the plane of the fastener chain, and being adapted to anchor the coupling head portions, an element-debris removing means including a pair of grippers for removing residual debris of fastener elements resulting from the severing thereof, said removing means being horizontally disposed in criss-cross relation to said severing means, an actuating means for moving said pair of grippers horizontally towards and away from each other, a splitting means for splitting open the abutting inner edges of the opposed stringer tapes,





mounted therein a vertically reciprocable punch 25 which has a bottom end 26 in abutting engagement with a pusher rod 27. The rod 27 is connected to and vertically moved by a suitable actuating means not shown. Raising the pusher rod 27 causes the punch 25 to move upwardly relative to the anvil 23 against tension of a spring member 28 accommodated within the anvil 23, and lowering the rod 27 allows the spring 28 to restore thereby urging the punch 25 into normally retracted position.

The die block 24, which is located above the anvil 23 according to the illustrated embodiment, is secured to a supporting plate 29 and is vertically movable together therewith. This vertical movement is effected by a pusher rod 30 in a manner similar to the aforesaid pusher rod 27. The die block 24 is provided with a vertical die slot 31 and with a spring-loaded die member 32 movable therein. The die member 32 has an upper end 33 connected to a spring member 34 accommodated in the block 23 and is normally urged downwardly toward the punch 25.

The punch 25 is provided at its tip end with bladed edges 25a which are dimensioned to fit into the die slot 31 and which constitute with the latter a coacting die cutter for severing the coupling head portions Ea of the fastener elements E. The punch 25 is positioned between and contiguous with the splitting members 22 in the opposed guide blocks 15a, 15b such that the bladed edges 25a of the punch 25 normally lie flush with the tip end 22a of each splitting member 22. The arrangement being that the punch 25 can readily intrude between the element-carrying edges of the opposed stringer tapes T which have been split open by the splitting members 22.

The element-debris removing means 14 comprises a pair of horizontally opposed grippers 35a, 35b which are positioned in criss-cross relation to the vertically disposed severing means 13, and an actuating means for moving these grippers toward and away from each other. Each of the grippers 35a, 35b consists of an elongated upper jaw 36 and a similar lower jaw 37 each having at one end inwardly directed claw 38 with which to grip the fastener elements E as better seen in Fig. 5. Both of these jaws are mounted coaxially on a pin 39 extending parallel with the path of the fastener chain F. The lower jaw 37 is slidable along a guide groove (not shown) in the table 11, and is provided at its bottom surface with a rack 40 engaging with a first sector gear 41 connected eccentrically to a driving rod 42, whereby the gripper 35a (35b) is moved horizontally towards and away from the severing means 13. At the opposite end of the upper jaw 36 is provided a cam roll 43

which engages with a cam plate 44 slidably along a guide groove (not shown) in the table 11. The cam plate 44 is provided at its bottom with a rack 45 engaging with a second sector gear 46 connected eccentrically to a driving rod 47, whereby the upper jaw 36 is imparted with a pivotal motion about the pin 39. Designated at 48 is a spring member adapted to bias the upper jaw 36 normally downwardly.

Reference is now made to Figs. 5a through 5h inclusive which illustrate a complete cycle of operation required to accomplish the removal of a desired length of fastener elements E in accordance with the invention.

In the first phase of the cycle shown in Fig. 5a, the fastener chain F on entry to the space-forming station is split open along the abutting inner longitudinal edges of the two opposed stringer tapes T by the splitting member 22 in each guiding means 12, whereupon the punch 25 intrudes between the thus split edges of the tapes T, with the bladed edges 25a abutting against the lower faces of the coupling head portions Ea of fastener elements E. This is followed by the second phase wherein the die block 24 descends together with the die member 32 until they come into abutting engagement with the upper faces of the coupling head portions Ea. The fastener elements E are thus retained firmly in position, being sandwiched between the punch 25 and the die block 24, as shown in Fig. 5b. The second phase of the cycle further includes rotation of the first sector gear 41 in a direction to cause the grippers 35a, 35b to move inwardly toward each other to a position wherein their jaws 36, 37 can grip the connecting portions Ec of the fastener elements E as still shown in Fig. 5b. The third phase then commences with rotation of the second sector gear 46 to move the cam plate 44 inwardly until the cam roll 43 rides on a first cam face 44a, whereupon the upper jaw 36 tilts down about the pin 39 so that its claw 38 lands upon the upper faces of the connecting portions Ec of fastener elements E and cooperates with the lower jaw 37 in loosely gripping the connecting portions Ec as shown in Fig. 5c. This is followed by the fourth phase of the cycle in which the grippers 35a, 35b are moved further inwardly by the rotation of the first sector gear 41 until the claws 38 of the respective jaws 36, 37 come approximately midpart of the arms Eb of fastener elements E shifting sewing threads S and other element-securing members inwardly towards the center of the interengaged elements E, as shown in Fig. 5d. The fifth phase takes place with further rotation of the second sector gear 46 to move the cam plate 44 further inwardly until the cam roll 43 leaves the first cam face 44a and



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said punch having bladed edges lying normally flush with said splitting member, a cam means for causing said grippers to hold the said length of fastener elements first loosely at the connecting portions thereof and then firmly at the arm portions to retain said length of elements against displacement during the severing thereof.

3. An apparatus as defined in claim 2 which further includes a guiding means including oppositely disposed guide blocks for guiding the movement of the fastener chain therebetween and holding the same in horizontal alignment.

4. An apparatus as defined in claim 2

wherein said actuating means comprises a sector gear engaging with a rack provided in each of said grippers.

5. A method substantially as herein described with reference to and as illustrated in the accompanying drawings. 20

6. An apparatus substantially as herein described with reference to and as illustrated in the accompanying drawings.

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