

# PATENT SPECIFICATION

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## (54) A METHOD AND APPARATUS FOR PRODUCING ELEMENT-FREE GAPS IN A CONTINUOUS FASTENER CHAIN

- (71) We, YOSHIDA KOGYO K. K., a corporation duly organised under the laws of Japan and existing at No. 1, Kanda Izumicho, 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:—
- 10 This invention relates to a method and apparatus for producing element-free gaps or spaces in a continuous fastener chain consisting of a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements which are formed by die-casting a metal or injection-molding a plastics material peripherally around a cord reinforcing the tape edge.
- 15 There have heretofore been proposed various methods and related apparatuses for the production of fastener element-free gaps in a continuous fastener chain of the type described. One of the methods known in the art is concerned with cutting coupling heads only off the fastener chain for a length corresponding to a desired gap to be formed, and thereafter removing the leg portions left in gripping engagement with the tape cord off the tape. Another method comprises the steps of pressing fastener elements into deformed, flattened configuration for a gap length as desired, and forcibly separating the deformed elements from the tape cord.
- 20 However, these prior art methods and related apparatuses have suffered from the drawback that the leg portions remaining on the tape cord or the deformed fastener elements were sometimes held in firm gripping engagement with the tape edge, with the result that the leg portions or deformed elements were difficult to be completely removed from the tape edge without damage thereto.
- 25 According to one aspect of the invention, there is provided a method of producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements secured to a cord reinforcing the tape edge, said method comprising the steps of: supporting the continuous fastener chain with coupling heads of the fastener elements exposed; severing the fastener elements for a length corresponding to a desired gap to be formed along the fastener chain into two portions along a single plane of severance such that the cord is intersected by the plane of severance, said severing starting at the coupling heads towards the cord; and removing the thus severed elements from the cord.
- 30 According to another aspect of the invention there is provided apparatus for producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements secured to a cord reinforcing the tape edge, said apparatus comprising: means for supporting the continuous fastener chain with coupling heads of the fastener elements exposed; means for severing the fastener elements for a length corresponding to a desired gap to be formed along the fastener chain into two portions along a single plane of severance such that the cord is intersected by the plane of severance, said severing starting at the coupling heads towards the cord; and means for removing the thus severed elements from the cord.
- 35 According to another aspect of the invention there is provided apparatus for producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements secured to a cord, said apparatus com-

prising; a bed; first guide means provided at said bed; a fastener chain support fixed to said bed for supporting the fastener chain with coupling heads of the fastener elements faced upwardly; a pair of element holding means horizontally slidable on said bed and normally urged to hold the fastener elements therebetween supported by said fastener chain support; punch holding means disposed in opposed relationship with and vertically reciprocable toward and away from said bed; second guide means provided at said punch holding means for coaxing with said first guide means; a punch means fixed to and projecting downwardly from said punch holding means; said punch means being in vertical registry with said fastener chain support and adapted to thrust into the coupling heads toward the cord to sever the fastener elements supported by the fastener chain support; and remover means movably mounted in said punch holding means and adapted to remove the severed elements off from the fastener chain, said remover means co-operating with the vertical movement of said punch holding means in performing the function thereof.

The invention will be described by way of example with reference to the accompanying drawings in which like reference characters or numerals refer to like or corresponding parts throughout the several views and wherein:

Figure 1 is a fragmentary plan view of a carrier tape carrying along its one longitudinal edge discrete fastener elements with a series of spaced element-free gaps formed therealong;

Figure 2 is a vertical cross sectional view of a preferred gap producing apparatus in accordance with the invention;

Figure 3 is a fragmentary perspective view with parts broken away of the apparatus as shown in Figure 2;

Figure 4 is a fragmentary vertical cross section on enlarged scale of the important operative parts of the apparatus and showing a row of fastener elements before these are severed off from the carrier tape;

Figure 5 is a similar view but showing an initial stage of the element severance operation;

Figure 6 is a similar view but showing the elements being severed off; and

Figure 7 is a similar view but showing the elements after they have completely been severed off the tape.

Referring now to the drawings and Figure 1 in particular, there is shown a continuous fastener chain F comprising a carrier tape T carrying along its one longitudinal edge discrete fastener elements E which are formed by die-casting a metal or

injection-molding a plastics material. The longitudinal tape edge is reinforced with a cord C about which the elements E are mounted in firm gripping engagement therewith. Designated at G is an element-free gap as produced by the method and apparatus according to this invention, as hereinafter described in detail.

Referring to FIGS. 2 and 3, generally designated at 10 is a preferred embodiment of a gap producing apparatus of this invention which comprises a bed 11, a fastener chain support 12 fixed to the bed 11, a punch holding block 13 disposed in opposed relationship with and vertically reciprocable toward and away from the bed 11, and a blade-shaped punch 14 fixed to and projecting downwardly from the block 13 in vertical registry with the fastener chain support 12. The bed 11 is formed at its lateral sides with a pair of upwardly opening guideways 15 adapted to slidably receive therein a pair of guide members later described. Formed centrally in the bed 11 is a scrap receiving chamber 16 within which is located the fastener chain support 12 projecting upwardly from the bottom of the chamber 16 and terminating at the level of the upper surface of the bed 11. The fastener chain support 12 is provided therein with a slot 17 having its upper end open for accommodating the carrier tape T and is tapered at its top portion for gripping engagement with the fastener chain F directly beneath the fastener elements E. Thus, the fastener chain F is held in place by the support 12 such that the elements E surrounding the cord C rest on the top end of the support 12 with the tape T accommodated in the slot 17 and with the coupling heads H (Figure 4) of the elements E facing toward a cutter blade later described.

The punch holding block 13 is provided at its lateral sides with a pair of guide members 18 projecting downwardly therefrom and adapted to slidably telescope within the guideways 15 of the bed 11 for guiding the upward and downward movement of the punch holding block 13. The guide members 18 are provided with cam members 19 which are formed at their lower ends of outwardly inclined cam surfaces 20 for the purposes later described. Provided laterally on the punch 14 are a pair of element removers 21 movable relative thereto and slidably fitted in a cavity 22 defined in the block 13. Housed in the cavity 22 and abutting against the upper ends of the removers 21 are a pair of compression springs 23 which normally bias the removers 21 downwardly.

The removers 21 each have an outwardly inclined surface 24 at its lower end and a transversely protruding member 25

at its upper portion for abutting engagement with a shoulder 26 of the cavity 22 to restrict the downward movement of the remover 21 against the tension of the spring 23.

As best seen in Figure 3, a plurality of cutter blades 27 are provided at the lower portion of the punch 14 which correspond in dimension and number to the elements E to be severed off from the carrier tape T for forming the element-free gap G. Bifurcated spacer arms 28 are formed integrally with the punch 14 and arranged alternately with the blades 27 in the longitudinal direction of the fastener chain F.

The spacer arms 28 which project downwardly from the punch 14 and extend beyond the tips of the blades 27 are formed with cutouts 29 for surrounding engagement with the cord C exposed between adjacent elements E. It is to be noted that the cutouts 29 are spaced apart from the blades 27 by a predetermined distance later explained.

Designated at 30 are a pair of element holders which are horizontally slidable on the bed 11 toward and away from each other in the transverse direction of the fastener chain F and are normally urged inwardly toward each other by compression springs suggested at dotted serrated lines 31, thereby holding the elements E firmly in place between their inner ends 32.

Formed at the upper edges of the holder inner ends 32 are bevels 33 fashioned for face-to-face contact with the inclined surfaces 24 when the removers 21 are lowered. Also formed at the inner ends 32 of the holders 30 are longitudinally spaced-apart recesses 34 arranged in vertical alignment with the spacer arms 28 and adapted to admit them therethrough when the punch 14 is in its lowered position. There are defined in the holders 30 a pair of openings 35 which are adapted to receive the cam members 19 when the holders 30 are moved outwardly or into their retracted position. The openings 35 are provided at their upper edges with bevels 36 configured for face-to-face contact with the cam surfaces 20 when the punch holding block 13 is lowered. Indicated by 37 are cover plates fitted over the element holders 30 for protective purposes.

Now, the mode of operation of the gap producing apparatus 10 thus constructed will be hereinafter described with particular reference to Figures 4 to 7 wherein the sequential steps of gap production are illustrated. As seen in Figure 4, the element E supported on the fastener chain support 12 is held in place in sandwiched relation to the spring-loaded element holders 30 with the coupling head H faced upwardly in vertical registry with the path

of the blade-shaped punch 14. As the punch holding block 13 descends, the punch 14 and the mating spring-loaded removers 21 are lowered together until the inclined surfaces 24 of the removers 21 are brought into face-to-face contact with the bevels 33 of the element holders 30. Upon the face-to-face contact with the bevels 33, the removers 21 are prevented from excess downward movement against the tension of the compression spring 23 because the element holders 30 are in their innermost position. During which time, the punch 14 continues to descend with the block 13 until the blade 27 begins to thrust into the coupling heads H to remove the coupling elements E. Accordingly, a length of elements E is severed centrally into two identical parts along a longitudinal plane extending centrally from the coupling head H to the cord C as shown in Figure 6. Concurrent with this, the outwardly inclined cam surfaces 20 of the cam members 19 are driven into face-to-face engagement with the bevels 36 of the element holders 30 and their continued downward movement urges the holders 30 to move outwardly, or retract them away from each other. Thus, the removers 21 are allowed to again move downwardly with the inclined surfaces 24 sliding on the bevels 33, as depicted in Figure 6. The punch 14 is then brought to a stop as the cutouts 29 engage peripherally with the cord C. Figure 7 shows the final step of the element severance operation wherein the removers 21 force severed elements E apart from the carrier tape T into the scrap receiving chamber 16 without damage to the tape.

It will be appreciated that because the cutouts 29 are spaced apart from the blade 27, the cord C surrounded by the cutouts 29 does not contact the blade 27 and hence is not damaged thereby in the severance operation. With this element severance operation, the elements are readily cut into halves and completely severed off the fastener chain F in a simple manner without damage to the carrier tape T.

After the complete severance of the element E, the punch 14 and removers 21 are raised upwardly out of engagement with the cord C and element holder 30 respectively, whereupon the holders 30 are urged inwardly toward each other under the influence of the compression springs 31.

In this manner, all operative parts of the gap production apparatus are brought back into their initial position to repeat the gap production operation.

#### WHAT WE CLAIM IS:

1. A method of producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one long-

at its upper portion for abutting engagement with a shoulder 26 of the cavity 22 to restrict the downward movement of the remover 21 against the tension of the spring 23.

As best seen in Figure 3, a plurality of cutter blades 27 are provided at the lower portion of the punch 14 which correspond in dimension and number to the elements E to be severed off from the carrier tape T for forming the element-free gap G. Bifurcated spacer arms 28 are formed integrally with the punch 14 and arranged alternately with the blades 27 in the longitudinal direction of the fastener chain F.

The spacer arms 28 which project downwardly from the punch 14 and extend beyond the tips of the blades 27 are formed with cutouts 29 for surrounding engagement with the cord C exposed between adjacent elements E. It is to be noted that the cutouts 29 are spaced apart from the blades 27 by a predetermined distance later explained.

Designated at 30 are a pair of element holders which are horizontally slidable on the bed 11 toward and away from each other in the transverse direction of the fastener chain F and are normally urged inwardly toward each other by compression springs suggested at dotted serrated lines 31, thereby holding the elements E firmly in place between their inner ends 32.

Formed at the upper edges of the holder inner ends 32 are bevels 33 fashioned for face-to-face contact with the inclined surfaces 24 when the removers 21 are lowered. Also formed at the inner ends 32 of the holders 30 are longitudinally spaced-apart recesses 34 arranged in vertical alignment with the spacer arms 28 and adapted to admit them therethrough when the punch 14 is in its lowered position. There are defined in the holders 30 a pair of openings 35 which are adapted to receive the cam members 19 when the holders 30 are moved outwardly or into their retracted position. The openings 35 are provided at their upper edges with bevels 36 configured for face-to-face contact with the cam surfaces 20 when the punch holding block 13 is lowered. Indicated by 37 are cover plates fitted over the element holders 30 for protective purposes.

Now, the mode of operation of the gap producing apparatus 10 thus constructed will be hereinafter described with particular reference to Figures 4 to 7 wherein the sequential steps of gap production are illustrated. As seen in Figure 4, the element E supported on the fastener chain support 12 is held in place in sandwiched relation to the spring-loaded element holders 30 with the coupling head H faced upwardly in vertical registry with the path

of the blade-shaped punch 14. As the punch holding block 13 descends, the punch 14 and the mating spring-loaded removers 21 are lowered together until the inclined surfaces 24 of the removers 21 are brought into face-to-face contact with the bevels 33 of the element holders 30. Upon the face-to-face contact with the bevels 33, the removers 21 are prevented from excess downward movement against the tension of the compression spring 23 because the element holders 30 are in their innermost position. During which time, the punch 14 continues to descend with the block 13 until the blade 27 begins to thrust into the coupling heads H to remove the coupling elements E. Accordingly, a length of elements E is severed centrally into two identical parts along a longitudinal plane extending centrally from the coupling head H to the cord C as shown in Figure 6. Concurrent with this, the outwardly inclined cam surfaces 20 of the cam members 19 are driven into face-to-face engagement with the bevels 36 of the element holders 30 and their continued downward movement urges the holders 30 to move outwardly, or retract them away from each other. Thus, the removers 21 are allowed to again move downwardly with the inclined surfaces 24 sliding on the bevels 33, as depicted in Figure 6. The punch 14 is then brought to a stop as the cutouts 29 engage peripherally with the cord C. Figure 7 shows the final step of the element severance operation wherein the removers 21 force severed elements E apart from the carrier tape T into the scrap receiving chamber 16 without damage to the tape.

It will be appreciated that because the cutouts 29 are spaced apart from the blade 27, the cord C surrounded by the cutouts 29 does not contact the blade 27 and hence is not damaged thereby in the severance operation. With this element severance operation, the elements are readily cut into halves and completely severed off the fastener chain F in a simple manner without damage to the carrier tape T.

After the complete severance of the element E, the punch 14 and removers 21 are raised upwardly out of engagement with the cord C and element holder 30 respectively, whereupon the holders 30 are urged inwardly toward each other under the influence of the compression springs 31.

In this manner, all operative parts of the gap production apparatus are brought back into their initial position to repeat the gap production operation.

#### WHAT WE CLAIM IS:

1. A method of producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one long-



itudinal edge a series of discrete fastener elements secured to a cord reinforcing the tape edge, said method comprising the steps of: supporting the continuous fastener chain with coupling heads of the fastener elements exposed; severing the fastener elements for a length corresponding to a desired gap to be formed along the fastener chain into two portions along a single plane of severance such that the cord is intersected by the plane of severance, said severing starting at the coupling heads towards the cord; and removing the thus severed elements from the cord.

2. An apparatus for producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements secured to a cord reinforcing the tape edge, said apparatus comprising: means for supporting the continuous fastener chain with coupling heads of the fastener elements exposed; means for severing the fastener elements for a length corresponding to a desired gap to be formed along the fastener chain into two portions along a single plane of severance such that the cord is intersected by the plane of severance, said severing starting at the coupling heads towards the cord; and means for removing the thus severed elements from the cord.

3. An apparatus for producing element-free gaps in a continuous fastener chain having a carrier tape carrying along its one longitudinal edge a series of discrete fastener elements secured to a cord, said apparatus comprising: a bed; first guide means provided at said bed; a fastener chain support fixed to said bed for supporting the fastener chain with coupling heads of the fastener elements faced upwardly; a pair of element holding means horizontally slidable on said bed and normally urged to hold the fastener elements therebetween supported by said fastener chain support; punch holding means disposed in opposed relationship with and vertically reciprocable toward and away from said bed; second guide means provided at said punch holding means for coacting with said first guide means; a

punch means fixed to and projecting downwardly from said punch holding means, said punch means being in vertical registry with said fastener chain support and adapted to thrust into the coupling heads toward the cord to sever the fastener elements supported by the fastener chain support; and remover means movably mounted in said punch holding means and adapted to remove the severed elements off from the fastener chain, said remover means cooperating with the vertical movement of said punch holding means in performing the function thereof.

4. An apparatus as claimed in claim 3 in which said element holding means are provided with a pair of compression springs to normally urge said means to hold the fastener elements and at their upper surfaces with bevels.

5. An apparatus as claimed in claim 4 in which said second guide means are provided with outwardly inclined cam surfaces fashioned to face-to-face contact with said bevels, whereby said element holding means are forced out of holding engagement with the fastener elements when said punch holding means is lowered.

6. An apparatus as claimed in claim 3, 4 or 5 in which said remover means are provided with a compression spring to normally urge said remover means downwardly.

7. An apparatus as claimed in claim 6 in which said remover means are adapted to descend between the element holding means thereby removing the severed elements off from the fastener chain, when said element holding means are forced out of holding engagement with the fastener elements.

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

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

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