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APPARATUS FOR AUTOMATICALLY

PROCESSING A SLIDE FASTENER CHAIN

The present invention relates to the manufacture of trouser closures for fly openings, and more particularly to an apparatus for automatically processing a slide fastener chain to which a succession
5 of fly strips is attached.

In the manufacture of trouser closures for fly openings from a continuous slide fastener chain to which a succession of fly strips is attached, it is customary to form element-free gaps in the fastener
10 chain near or at ends of the successive fly strips and also to sever the fastener chain at such element-free portions. Japanese Patent Laid-Open Publication (Kokai) 56-3003, published on January 13, 1981, discloses an apparatus which includes a vertically
15 movable combined cutter having a cross-shaped cutting edge. The combined cutter, when lowered, breaks off several fastener elements to form an element-free gap in the fastener chain and, at the same time, severs the

fastener chain at such element-free portion.

However, in this prior apparatus, the feeding and discharging of the fastener chain is carried out manually, which is laborious and time-consuming.

5 In a hypothetical arrangement that a pair of intermittently operative feed rollers for the fastener chain is disposed upstream of the combined cutter to automate the prior apparatus, jamming of the fastener chain tends to occur at a cutting station where a guide
10 for a pair of interengaged fastener element rows is located. Otherwise, if the feed rollers are disposed downstream of the combined cutter, proper intermittent feeding of the fastener chain at the upstream side of the combined cutter cannot be achieved. Yet, using a
15 gripping mechanism to feed the fastener chain, which mechanism is relatively complex in structure, makes the apparatus oversized and hence expensive.

According to the present invention, there is provided an apparatus for automatically processing a
20 slide fastener chain to which a succession of fly strips is attached, comprising: (a) an intermittently operative feed unit for feeding the fastener chain longitudinally along a path; (b) a first cutting unit, disposed on the path upstream of said feed unit, for
25 forming an element-free portion in the fastener chain while said feed unit is inoperative; (c) a second cutting unit, disposed on the path downstream of said

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feed unit, for severing the fastener chain transversely across the element-free portion while said feed unit is inoperative; (d) a measuring unit, disposed on the path upstream of said first cutting unit, for producing a
5 number of electrical signals, depending on the amount of the fastener chain having been fed through said measuring unit; (e) a detector, disposed on the path between said first cutting unit and said measuring unit, for producing a signal pulse each time
10 confronting ends of each adjacent pair of the successive fly strips arrive at said detector; and (f) a processing circuit electrically connected to said detector and said measuring unit for, upon receipt of one signal pulse from said detector, counting the
15 electrical signals having been issued from said measuring unit, and for producing a first output signal, when the number of the counted electrical signals reaches a first predetermined value corresponding to the distance between said first
20 cutting unit and said detector to de-energize said feed unit and, at the same time, to energize said first cutting unit, and also for producing a second output signal, when the number of the counted electrical signals reaches a second predetermined value
25 corresponding to the distance between said second cutting unit and said detector, to de-energize said feed unit and, at the same time, to energize the second

cutting unit.

It is believed possible by means of the present invention to provide an automatic apparatus for forming element-free gaps in a slide fastener chain, to which
5 a succession of fly strips is attached, and for severing the fastener chain at such element-free portions in timed relation with the formation of the element-free gaps, without jamming of the fastener chain.

It is also believed possible by means of the
10 present invention to provide an automatic, slide-fastener-chain processing apparatus which is simple in construction and hence inexpensive.

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

Figure 1 is a fragmentary front elevational view, with parts broken away, of an apparatus embodying the present invention;

Figure 2 is a cross-sectional view taken along
20 line II-II of Figure 1;

Figure 3 is an enlarged, fragmentary perspective view of the primary parts of the apparatus;

Figure 4 is a fragmentary bottom view of a slide fastener chain to which a succession of fly strips is
25 attached;

Figure 5 is a transverse cross-sectional view taken along line V-V of Figure 4;

Figure 6 is a fragmentary side elevational view of the slide fastener chain, showing second flaps of the fly strips having been deflected;

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

Figure 8 is a fragmentary side elevational view of the slide fastener chain, showing an adjacent pair of the second flaps with a triangular space provided between their confronting ends;

Figure 9 is a fragmentary perspective view corresponding to Figure 8; and

Figures 10A, 10B and 10C are fragmentary front elevational views of the primary parts of the apparatus, illustrating the manner in which a slide fastener, with a fly strip attached thereto, is progressively manufactured.

Figures 1 to 3 show an apparatus 100 for automatically manufacturing slide fasteners for trouser closures for fly openings, from a slide fastener chain 1. As shown in Figures 3 - 5, the fastener chain 1 includes a succession of fly strips 4 connected end to end in substantially abutting relation by a pair of continuous stringer tapes 3, 3 supporting on their inner longitudinal edges a pair of interengaged rows of fastener elements 2, 2. The

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successive fly strips 4 are attached to one of the stringer tapes 3 by sewn stitches 5, dividing each fly strip 4 into a first and a second flap 4a, 4b. As better shown in Figure 5, the first flap 4a overlaps only one tape 3 in close relation therewith, while the second flap 4b overlaps not only the other tape 3 but also the pair of interengaged fastener element rows 2 with a relatively small gap between the second flap 4b and the other tape 3.

10 The apparatus 100 generally comprises a first cutting unit 10 for breaking off several fastener elements 2 of the fastener chain 1 to form an element-free gap 8 (Figure 3) in a pair of interengaged fastener element rows 2, a feed unit 30 disposed
15 downstream of the first cutting unit 10 for feeding the fastener chain 1 along a longitudinal doglegged path 9 (hereinafter referred to as "chain path"), a second cutting unit 50 disposed downstream of the feed unit 30 for severing the fastener chain 1 transversely across
20 such element-free portion, a measuring unit 60 disposed upstream of the first cutting unit 10 for measuring the length of the fastener chain 1 having been fed by the feed unit 30, and a detector 70 disposed between the measuring unit 60 and the first cutting unit 10 for
25 detecting ends of the successive fly strips 4.

 The first cutting unit 10 (Figure 1) includes a pair of (upper and lower) cutter guides 12, 12 fixed to

a frame 11 in confronting relation to one another with respect to the chain path 9, a first ram 13 disposed above the upper cutter guide 12 and vertically slidably supported on the frame 11, and an element cutter 14
5 mounted on a lower end of the first ram 13.

The first ram 13 is connected at its upper end to a vertically slidable press ram (not shown) via a connecting rod 15 and has at its lower end a fastener-chain positioning bar 16, the connecting rod
10 15 being connected to the ram 13 by means of a pin 20. The positioning bar 16 is inserted at its upper end into a blind hole 17 in the first ram 13 and is inclined downwardly to the upstream side of the apparatus 100. A compression spring 18 is mounted in
15 the blind hole 17 of the first ram 13, acting between the latter and the positioning bar 16 to normally urge a pawl 19 of the positioning bar 16 to project downwardly beyond a cutting edge of the element cutter 14.

20 As shown in Figure 3, the cutting edge of the element cutter 14 has a rectangular face vertically aligned with the center line of the chain path 9, i.e. the center line of the pair of interengaged fastener element rows 2 of the fastener chain 1. The feed unit
25 30 includes a pair of (lower and upper) feed rollers 31, 32, a fastener-chain guide 33 extending alongside the chain path 9 at the upperside thereof, and a pair

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of fly-strip guides 34, 34 (Figures 1 and 2) disposed opposite to each other with respect to the chain path 9.

The lower feed roller 31, as shown in Figure 2, has an annular groove 29 extending in and along a peripheral surface of the roller 31, and is mounted on one end (right end in Figure 2) of a first shaft 36 rotatably supported by the frame 11 via a pair of bearings 35, 35. Likewise, the upper feed roller 32 has an annular groove 28 extending in and along a peripheral surface of the roller 32, and is mounted on one end (right end in Figure 2) of a second shaft 39 rotatably supported by a support 38 via a pair of bearings 37, 37. A first gear 40 is mounted on the first shaft 36 at the other side (left side in Figure 2) thereof and meshes with a second gear 41 mounted on the other end of the second shaft 39. Mounted at the other end of the first shaft 36 is a pulley 42 which is operatively connected with a drive source (not shown) such as a motor by means of an endless belt 43 wound around the pulley 42.

The support 38 is vertically movably supported by the frame 11 and is normally urged downwardly by a compression spring 44 (Figures 1 and 2), causing the upper roller 32 and the second gear 41 to be pressed against the lower roller 31 and the first gear 40, respectively.

A fastener-element guide 33 is disposed adjacent to the upper feed roller 32. As better shown in Figure 3, the fastener-element guide 33 has at its upper side a longitudinal ledge 27 and at its lower side a longitudinal guide groove 26. The ledge 27 of the fastener-element guide 33 is received in the groove 28 of the upper feed roller 32, and the pair of interengaged fastener element rows 2 of the fastener chain 1, as the latter is fed, is received in the guide groove 26 of the guide 33, thus preventing lateral displacement of the fastener chain 1.

The second cutting unit 50, as shown in Figure 1, includes a second ram 51 vertically movably supported by the frame 11, a fastener-chain cutter 52 mounted on a lower end of the second ram 51, a cutter die 53 fixed to the frame 11 in confronting relation to the cutter 52 with respect to the chain path 9, and a fluid-pressurized cylinder 54 operatively connected to the second ram 51 for vertically moving the second ram 51 and thus the cutter 52. The cylinder 54 is fixed to the frame 11 by a bracket 58. A threaded bolt 55 is carried by the second ram 51, and a pair of (upper and lower) limit switches 56, 57 fixed to the frame 11 by a bracket 59; each limit switch 56, 57 is actuated by the bolt 55 in response to the vertical movement of the second ram 51, thus detecting the upper or lower end of the stroke of the second ram 51. Each limit switch 56,

57, when actuated, produces an electrical signal to energize or de-energize the cylinder 54, thus limiting upward and downward movement of the fastener-chain cutter 52.

5 The measuring unit 60 (Figure 1) includes a pair of idle rollers 61, 62 which corotates as the fastener chain 1 is fed by the feed rollers 31, 32, and the unit 60 produces a number of electrical signals, depending on the number of revolutions of one of the idle rollers
10 61, 62, i.e. the amount of the fastener chain 1 having been fed. The electrical signals are applied to a known processing circuit 80 (Figure 1) which then produces output signals to control the feeding of the fastener chain 1 in timed relation with the
15 intermittent operation of the first and second cutting units 10, 50 in a manner described below.

As shown in Figure 9, the detector 70 is disposed adjacent to the turning point 9a (Figure 1) of the chain path 9 for sensing the presence of a
20 triangular space 73 (described below) between an adjacent pair of the second flaps 4b having been deflected in a manner described below. The detector 70 includes a light source 71 positioned on one side of the path of the second flaps 4b, and a photo-
25 electric transducer element 72 positioned on the other side of the path of the second flaps 4b for receiving the light passed trough the triangular space 73 when

confronting ends of an adjacent pair of the fly strips 4 arrive at the turning point 9a. The photoelectric transducer element 72 produces a pulse signal every time each triangular space 72 is sensed by the detector 5 70. Thus the pulse signal indicates that the confronting ends of an adjacent pair of the second flaps 4b, i.e. a trailing end of the corresponding preceding fly strip 4 and a leading end of the corresponding succeeding fly strip 4, have arrived at 10 the turning point 9a.

In operation, as the feed unit 30 is energized, the fastener chain 1 is fed along the chain path 9 through the measuring unit 60, the turning point 9a, the first cutting unit 10, the feed unit 30, and the 15 second cutting unit 50 in the order mentioned.

Initially, the succession of fly strips 4, with the first flaps 4a overlapping the tape 3 and with the second flaps 4b overlapping both the other tape 3 and the pair of interengaged fastener element rows 2 20 (Figures 4 and 5), are fed through the measuring unit 60 toward the turning point 9a. By the time each fly strip 4 arrives at the turning point 9a, the corresponding second flap 4b is deflected or moved aside progressively by a known deflector (not shown) 25 until the second flap 4b lies at a right angle with respect to the general plane of the fastener chain 1 as shown in Figures 6 and 7.

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The fly strip 4, with the deflected second flap 4b, is then moved to the turning point 9a where the direction of movement of the successive fly strips 4 is shifted, as shown in Figures 8 and 9. A relatively large triangular space 73 is temporarily provided between the confronting ends of an adjacent pair of the successive second flaps 4b, 4b when the same confronting ends arrive at the turning point 9a. This relatively large inter-flap space 73 allows the light from the light source 71 to pass through the space 73 to reach the photoelectric transducer element 72. The photoelectric transducer element 72 produces a signal pulse, which indicates that a trailing end of the preceding fly strip 4 and a leading end of the succeeding fly strip 4 have arrived at the turning point 9a. Upon receipt of the signal pulse from the photoelectric transducer element 72, the processing circuit 80 starts to count the electrical signals from the measuring unit 60. When the number of the counted electrical signals reach a first predetermined value corresponding to the distance between the first cutting unit 10 and the turning point 9a, the processing circuit 80 produces a first output signal, whereupon a drive (not shown) for the feed roller 31 is de-energized to terminate the feeding of the fastener chain 1 and, at the same time, a press ram (not shown) for the first cutting unit 10 is energized. At that

time the confronting ends of an adjacent pair of the successive fly strips 4 are in vertical registration with the element cutter 14.

As the successive fly strips 4 travel from the turning point 9a to the first cutting unit 10, the second flap 4b of each fly strip 4 is progressively folded over the corresponding first flap 4a.

The ram 13, upon energization of the non-illustrated press ram, is moved downwardly, together with the element cutter 14 and the fastener-chain positioning bar 16. As a result, the pawl 19 of the positioning bar 16 projects into an adjacent pair of fastener element rows 2 to retain the fastener chain 1 and, at the same time, the element cutter 14 projects through the pair of interengaged fastener-element rows 2 to break off several fastener elements 2 (Figure 10A). Thus an element-free gap 8 has been provided in the pair of interengaged fastener element rows 2.

Then, the ram 13 is moved upwardly, together with the element cutter 14 and the positioning bar 16. A limit switch (not shown) produces an electrical signal when the ram 13 returns to its raised position (Figure 10B). Upon receipt of the electrical signal from the non-illustrated limit switch, the non-illustrated drive for the feed unit 30 is energized, and the feed rollers 31, 32 restarts to

rotate to feed the fastener chain 1.

When the next signal pulse from the detector 70 is issued, i.e. when the number of the counted electrical signals from the measuring unit 60 reaches a
5 second predetermined value corresponding to the distance between the second cutting unit 50 and the turning point 9a, the processing circuit 80 produces a second output signal to de-energize the feed unit 30. At that time the element-free gap 8 of the fastener
10 chain 1 is in vertical registration with the fastener-chain cutter 52. The distance between the second cutting unit 50 and the turning point 9a equals to the length of the individual fly strip 4. Concurrently with this de-energization of the feed unit
15 30 and upon receipt of the second output signal from the processing circuit 80, the second cutting unit 50 is energized to cause the fastener-chain cutter 52 to descend to sever the fastener chain 1 transversely across the element-free portion 8 (Figure 10C). Thus a
20 slide fastener 1' (Figure 10C) for a "fly-opening" closure has been manufactured.

When the fastener-chain cutter 52 reaches the lowered position, the bolt 55 (Figure 1) carried by the second ram 51 hits an actuator of the lower limit
25 switch 57 which then produces an electrical signal. Upon receipt of this electrical signal, the processing circuit 80 produces an output signal to reverse the

cylinder 52, causing the fastener-chain cutter 52 to ascend. When the fastener-chain cutter 52 reaches the raised position, the bolt 55 hits an actuator of the upper limit switch 56 which then produces an electrical
5 signal. Upon receipt of this electrical signal, the processing unit 80 produces an output signal to de-energize the cylinder 52. Finally, the slide fastener 1' is discharged to a tray or a peripheral apparatus (both not shown) by a non-illustrated
10 suitable feed means.

According to the apparatus 100, since the element cutter 14 and the fastener-chain cutter 52 are disposed upstream and downstream, respectively, of the fastener-chain feed rollers 31, 32, it is possible to
15 manufacture a number of slide fasteners for fly-opening closures successively without jamming.

Another advantage of the apparatus 100 is that although the element cutter 14 and the fastener-chain cutter 52 are disposed remotely from one another, it is
20 possible to automate both the formation of element-free gaps 8 and the severing of the fastener-chain 1, partly because the measuring rollers 61, 62 and the fly-strip detector 70 are disposed upstream of the element cutter 14 so that the fly-strip detector 70 is disposed
25 between the element cutter 14 and the measuring rollers 61, 62 and partly because the detector 70 and the measuring rollers 31, 32 produce electrical signals

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which are sent to a processing circuit to control the operation of the two cutters 14, 52 independently in timed relation to one another. With this arrangement, both the formation of element-free gaps 8 and the
5 severing of the fastener chain 1 can take place accurately near or at ends of the successive fly strips 4, irrespective of the length of the fly strips 4.

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Claims:-

1. An apparatus for automatically processing a slide fastener chain to which a succession of fly strips is attached, comprising:

- (a) an intermittently operative feed unit for
5 feeding the fastener chain longitudinally along a path;
(b) a first cutting unit, disposed on the path upstream of said feed unit, for forming an element-free portion in the fastener chain while said feed unit is inoperative;
10 (c) a second cutting unit, disposed on the path downstream of said feed unit, for severing the fastener chain transversely across the element-free portion while said feed unit is inoperative;

- (d) a measuring unit, disposed on the path upstream of said first cutting unit, for producing a
15 number of electrical signals, depending on the amount of the fastener chain having been fed through said measuring unit;

- (e) a detector, disposed on the path between said
20 first cutting unit and said measuring unit, for producing a signal pulse each time confronting ends of each adjacent pair of the successive fly strips arrive at said detector; and

- (f) a processing circuit electrically connected to
25 said detector and said measuring unit for, upon receipt of one signal pulse from said detector, counting the electrical signals having been issued from said measuring



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unit, and for producing a first output signal, when the number of the counted electrical signals reaches a first predetermined value corresponding to the distance between said first cutting unit and said detector to
5 de-energize said feed unit and, at the same time, to energize said first cutting unit, and also for producing a second output signal, when the number of the counted electrical signals reaches a second predetermined value corresponding to the distance between said
10 second cutting unit and said detector, to de-energize said feed unit and, at the same time, to energize the second cutting unit.

2. An apparatus according to claim 1, said distance between said second cutting unit and said detector
15 being equal to the length of each of the fly strips.

3. An apparatus according to claim 1 or 2, said measuring unit comprising a pair of idle rollers which is corotatable as the fastener chain is fed by said feed unit and which produces a number of the electrical
20 signals depending on the number of revolutions of one of the idle rollers.

4. An apparatus according to claim 1, 2 or 3, said detector comprising a light source positioned on one side of the path of the fly strips, and a photoelectric
25 transducer element positioned on the other side of the path of the fly strips for receiving the light passed through a space between confronting ends of an adjacent pair of the successive fly strips.
