

- 1 -

METHOD AND APPARATUS FOR FORMING A SPACE
SECTION IN A PAIR OF CONTINUOUS
CONCEALED-SLIDE-FASTENER STRINGERS

The present invention relates to the production of slide fasteners, and more particularly to a method of and an apparatus for forming an element-free space section in a pair of continuous
5 concealed-slide-fastener stringers.

A number of devices for the purpose described above are known in which a chain of interengaged filamentary coupling elements attached by sewn stitches to a pair of continuous tapes along their folded inner
10 longitudinal edges is cut for a length corresponding to the length of an element-free space section by means of a punch and a die. It has been a common practice to this end that the tapes are pulled apart locally in order to allow the punch to enter between the adjacent
15 tape edges so that the cutting of the coupling elements is accomplished without cutting the tapes. However, pulling the tapes locally would often make the tapes to become unrecoverably deformed or otherwise damaged. Further, due to this tape pulling, an increased rate of

production with the prior apparatus is difficult to achieve. Such prior art is exemplified by U.S. Patent 3,225,430, issued December 28, 1985, and French Patent 1,561,401, issued March 28, 1969.

5 A solution has been proposed by Japanese Utility Model Publication (Jikkosho) 51-4802, in which a guide member having a tapering forward end portion is employed to force the adjacent folded tape edge portions split to expose head portions of a series of
10 the interengaged coupling elements. A punch is moved toward a die through a rectangular opening in the guide member to cut the exposed head portions of the coupling elements supported on the die. However, since it is necessary to force the guide member against the
15 coupling elements all the time, high-speed feeding of the fastener stringers through the apparatus cannot be achieved, and the coupling elements can be easily damaged by the guide member. Further, in this prior apparatus, the head portions of the coupling elements
20 are only cut with the leg portions remaining on the folded tape edges and, therefore, it is impossible to form a space section perfectly free from any coupling element piece.

According to a first aspect of the present
25 invention, there is provided a method of forming a space section in a pair of concealed-slide-fastener stringers including a pair of continuous tapes carrying

- 3 -

along their folded inner longitudinal edges a pair of rows of interengaged filamentary coupling elements, each coupling element row being attached to the respective folded tape edge by sewn stitches, said method comprising:

5 gripping the tapes with the interengaged coupling elements disposed at the upper side of the tapes; with the tapes gripped, pushing the fastener stringers upwardly from the under side of the tapes by a pair of laterally spaced and vertically movable dies until head

10 portions of a series of the interengaged coupling elements are exposed to the dies and then supported thereon; cutting certain interengaged coupling elements on the dies by a vertically movable punch coactive with the dies; and with the tapes gripped, pulling the cut

15 coupling elements out of the sewn stitches by the punch and a vertically movable ejector with the cut coupling elements clamped between the punch and the ejector.

According to a second aspect of the present invention, there is provided an apparatus for forming a

20 space section in a pair of concealed-slide-fastener stringers including a pair of continuous tapes carrying along their folded inner longitudinal edges a pair of rows of interengaged filamentary coupling elements, each coupling element row being attached to the respective folded

25 tape edge by sewn stitches, said apparatus comprising: a support table having means defining a guide groove receptive of the fastener stringers with the

interengaged coupling elements disposed at the upper side of the tapes; a pair of spaced guide plates mounted on said support table in confronting relation to each other and defining an upper side of said guide groove, said guide plates having along their confronting edges a pair of step portions, respectively, for supporting the interengaged coupling elements together with the folded tape edges; a pressure pad and a pair of laterally spaced dies disposed in said support table and defining an under side of said guide groove, said pressure pad being vertically movable to grip the tapes against said guide plates, said dies being vertically movable and having a pair of elongated pushing edges projectable into a space between said step portions of said guide plates for pushing the fastener stringers upwardly from the under side of the tapes until head portions of a series of the interengaged coupling elements are exposed to said dies and then supported thereon; a punch vertically movable toward and away from said step portions of said guide plates for cutting certain interengaged coupling elements supported on said dies; an ejector vertically movably disposed between said dies and projectable beyond said pushing edges thereof through the space between said step portions of said guide plates for clamping the cut coupling elements against said punch for jointly removing the cut

coupling elements clamped therebetween; and means for actuating said pressure pad, said dies and said ejector in timed relation to one another.

It is believed possible by means of the invention to provide a method and an apparatus in which an element-free space section can be formed in a pair of continuous concealed-slide-fastener stringers accurately without deforming or otherwise damaging a pair of tapes.

It is also believed possible by means of the invention to provide a method and an apparatus for forming a perfectly element-free space section in a pair of continuous concealed-slide-fastener stringers without any coupling element pieces remaining on the tape edges.

It is also believed possible by means of the invention to provide such an apparatus which can be operated at high speed without risk of impairing a pair of element-supporting folded tape edges, causing an improved rate of production of adequate quality concealed slide fasteners.

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

Figure 1 is a vertical cross-sectional view of

an apparatus embodying the present invention;

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

Figures 3A through 3E are cross-sectional detail views illustrating the manner in an element-free space section is formed in a pair of continuous slide fastener stringers; and

Figure 4 is a fragmentary plan view of a pair of continuous slide fastener stringers having an element-free space section formed by the apparatus.

Figure 1 shows an apparatus for forming an element-free space section 83 (Figure 4) in a pair of continuous fastener stringers for the production of concealed slide fasteners. The concealed-slide-fastener stringers (Figure 4) include a pair of continuous tapes 82, 82 carrying along their folded inner longitudinal edges 81, 81 a pair of rows of interengaged continuous filamentary coupling elements 80 attached to the respective folded tape edges 81, 81 by sewn stitches 85, 85 (Figures 3A through 3E).

The apparatus generally comprises a support table 1 mounted on a stationary base 2, and a pair of spaced guide plates 40, 41 mounted on the support table 1 in confronting relation to each other. A pressure pad 12 and a pair of laterally spaced dies 30, 30 are disposed in a vertical bore 10 in the support table 1

and defining with the guide plates 40, 41 a guide groove receptive of the fastener stringers with the interengaged coupling elements 80 disposed at the upper side of the tapes 82, 82.

5 The guide plates 40, 41 have along their confronting edges a pair of step portions 42, 42, respectively, for supporting the interengaged coupling elements 80 together with the folded tape edges 81, 81. The guide plates 40, 41 are disposed one on each side
10 of the guide groove extending thereover toward and terminating short of each other. One guide plate 40 is fixed to the support table 1, while the other guide plate 41 is movable toward and away from the one guide plate 40 for a purpose described below.

15 The pressure pad 12 is upwardly movable toward the guide plates 40, 41 for gripping therewith portions of the tapes 82, 82 around a space-section length L (Figure 4) of the interengaged coupling element rows 80. The pressure pad 12 has on its top surface a pair
20 of parallel elongated lands 13, 13 disposed one at each side of the dies 30, 30, while the guide plates 40, 41 have in their under surfaces a pair of elongated recesses 43, 43 complementary to the lands 13, 13, respectively. Each guide plate 40, 41 also has an
25 elongated jaw 44 disposed between the respective step portion 42 and the respective recess 43. The lands 13, the recesses 43 and the jaws 44 jointly serve to

prevent the gripped tapes 82, 82 from being slipped or displaced on the gripping surfaces as shown in Figure 3B.

The dies 30, 30 are vertically movable and have
5 a pair of elongated pushing edges 30a, 30a projectable into a space between the step portions 42, 42 of the guide plates 40, 41 for pushing the fastener stringers upwardly from the under side of the gripped tapes 82, 82 until head portions of a series of the interengaged
10 coupling elements 80 are exposed to the dies 30, 30 and then supported thereon, as shown in Figure 3C. Preferably, the pushing edge 30a of each die 30 has a length slightly greater than the length L of an element-free or space section 83 (Figure 4) to be
15 formed.

A punch 70 is carried by a punch holder 72 vertically movably mounted on a pair of parallel posts 71 (only one shown in Figure 1) fixed to the base 2 of the apparatus. The punch holder 72 is adapted to be
20 connected to an upper plunger (not shown) for vertical motion. The punch 70 has a pair of laterally spaced, elongated cutting edges 73, 73 that are movable, in response to vertical movement of the punch 70, toward and away from the step portions 42, 42 of the guide
25 plates 40, 41 to cut a space-section length L of the interengaged rows of the coupling elements 80 only at their upper leg portions (remote from the tapes), as

shown in Figure 3D.

The punch 70 also has an elongated pressing edge 74 disposed centrally between the two cutting edges 73, 73 for pressing the head portion of the cut coupling elements 80 against the dies 30, 30 to crush the head portions, as shown in Figure 3D.

As shown in Figures 1 and 2, the apparatus also includes an ejector 32 vertically movably disposed between the dies 30, 30 and projectable beyond the pushing edges 30a, 30a thereof through the space between the step portions 42, 42 of the guide plates 40, 41 for clamping the cut coupling elements 80 against the punch 70. The ejector 32 is upwardly movable together with the punch 70 relative to the step portions 42, 42 of the guide plates 40, 41 and the dies 30, 30 for pulling the cut coupling elements 80 out of the sewn stitches 85, 85 while the tapes 82, 82 are gripped between the pressure pad 12 and the guide plates 40, 41. The ejector 32, the pressure pad 12 and the dies 30, 30 are operatively connected by a drive mechanism so as to be moved in timed relation to one another.

The drive mechanism includes a slide 5 disposed in the bore 10 of the support table 1 and operatively connected to a lower plunger 6 vertically reciprocable in the base 2, and a first and a second set of compression springs 7, 15. The first set of

compression springs 7 acts between the support table 1 and the slide 5 to urge the latter downwardly, while the second set of compression springs 15 acts between the pressure pad 12 and the slide 5 to vertically urge one away from the other. In response to upward motion of the lower plunger 6, the slide 5 is upwardly movable against the bias of the first and second sets of compression springs 7, 15 until the slide 5 is blocked by a pair of stop portions 8, 8 of the support table 1.

10 The drive mechanism further includes a die holder 24 vertically movably disposed in a vertical channel 11 in the pressure pad 12, an ejector holder 20 disposed beneath the die holder 24 and connected to the lower plunger 6 via a cylinder 21 for vertical
15 movements, and a third and a fourth set of compression springs 22, 29. The third set of compression springs 22 acts between the pressure pad 12 and the ejector holder 20 to vertically urge one away from the other, while the fourth set of compression springs 29 (Figure
20 2) acts between the support table 1 and the die holder 24 to urge the latter downwardly. As shown in Figure 2, each of the compression springs 29 of the fourth set is mounted around a bolt 28 fixed to an upper
horizontal projection 9 of the support table 1 and
25 extending through a lower horizontal projection 26 of the die holder 24.

The downward movement of each of the slide 5,

- 11 -

the ejector holder 20 and the die holder 24 is restricted by the base 2. In Figures 1 and 2, as the ejector holder 20 and the slide 5 are actuated by the lower plunger 6 to be moved upwardly against the bias of the first set of compression springs 7, the pressure pad 12 is raised, because of the second and third sets of compression springs 15, 22, from the lower position of Figures 1 and 3A in which there exists a first gap A (Figure 1) between the under surfaces of the guide plates 40, 41 and the upper surfaces of the pressure pad 12 and in which there exists a second gap B (Figure 1) between contact under surfaces 12a (Figure 3A) of the pressure pad 12 and the top surface of the die holder 24, to the upper position of Figure 3B in which the pressure pad 12 grips the tapes 82, 82 against the guide plates 40, 41.

As shown in Figure 2, the die holder 24 has a pair of step portions 27, 27 engageable with the top surface of the slide 5 and there exists a third gap C between the step portions 27 and the upper surface of the slide 5, the third gap C being equal to the sum of the first and second gaps A and B (Figure 1).

As shown in Figure 1, the movable guide plate 41 is urged by an extension spring 55 away from the fixed guide plate 40, i.e. leftwardly, the extension spring 55 being connected at one end to the movable guide plate 41 and at the other end to a block 53 fixed to

the support table 1. A stop 52 is supported on the block 53 and is movable between an upper position (Figure 2) and a lower position (not shown). In its upper position, the stop 52 projects above the top surface of the support table 1 to prevent the movable guide plate 61 from being moved away from the fixed guide plate 40. In its lower position, the stop 52 is retracted below the top surface of the support table 1 into an unnumbered vertical hole in the block 52 to allow the movable guide plate 41 to be moved away from the fixed guide plate 40. The vertical movement of the stop 52 between its upper and lower positions is accomplished by turning a handle. The handle includes a cam shaft 60 extending through an unnumbered horizontal hole of the block 53, a cam 61 formed on an inner end of the cam shaft 60 integrally therewith and engageable with a recess 52a of the stop 52, and a knob 62 mounted on an outer end of the cam shaft 60 for turning the cam 61. The stop 52 is urged to its upper position by a compression spring 59.

In initial loading operation, as the handle is turned through 180° in Figure 1, the stop 52 is forced downwardly by the cam 61 to its retracted position against the bias of the compression spring 59. The movable guide plate 41 is moved, under the force of the extension spring 55, from the position of Figure 1 to its retracted position (not shown) to expose the guide

groove widely. A pair of continuous fastener stringers for concealed slide fasteners is placed in the guide groove in such a manner that one coupling element row 80 and the corresponding folded tape edge 81 are supported on the step portion 42 of the fixed guide plate 40, with the tapes 82, 82 lying over the respective lands 13, 13. Then the movable guide plate 41 is returned to its original position (Figure 1) by hand in such a manner that the other coupling element row 80 and the corresponding folded tape edge 81 are supported on the step portion 42 of the movable guide plate 41. With the movable guide plate 41 held in the original position by hand, as the handle is turned for another 180°, the stop 52 is returned to its upper position to prevent the movable guide plate 41 from being moved back to its retracted position.

In space-section forming operation, as shown in Figure 3A, as the slide 5 and the ejector holder 20 are actuated by the lower plunger 6 to be moved upwardly against the bias of the first set of compression springs 7, the pressure pad 12 is raised due to the second and third sets of compression springs 15, 22. This upward movement of the pressure pad 12 continues until the pressure pad 12 grips the tapes 82, 82 against the guide plates 40, 41 (Figure 3B).

With continued upward movement of the slide 5, it comes into engagement with the step portions 27, 27

(Figure 2) of the die holder 24 and continues to move upwardly with the die holder 24, raising the dies 30, 30 (against the bias of the fourth set of compression springs 29) to push the fastener stringers from the under side of the tapes 82, 82 until head portions of a series of the interengaged coupling elements 80 are exposed to the dies 30, 30 and then supported on their elongated pushing edges 30a, 30a, as shown in Figure 3C.

As the punch 70 is then lowered toward the step portions 42, 42 of the guide plates 40, 41, the upper leg portions of certain interengaged coupling elements 80 supported on the pushing edges 30a, 30a are severed by the cutting edges 73, 73 and, at the same time, the head portions of the severed coupling elements 80 are compressed between the pressing edge 74 of the punch 70 and the pushing edges 30a, 30a of the dies 30, 30 to collapse (Figure 3D).

Then, as the ejector holder 20 is further raised by the lower plunger 6 against the bias of the fourth set of compression springs 29, the ejector 32 is moved upwardly to clamp the cut and collapsed coupling elements 80 between the ejector 32 and the punch 70 and continues moving upwardly together with the punch 70, pulling the cut and collapsed coupling elements 80 away from the tapes 82, 82 gripped between the pressure pad 12 and the guide plates 40, 41. As a result, the cut

- 15 -

coupling elements 80 have been removed out of the sewn stitches 85, 85 and thus from the folded tape edges 81, 81. The ejector 32 (lower plunger 6) then ceases its upward movement, while the punch 70 (non-illustrated upper plunger) continues to be raised to the position of Figures 1, 3A, 3B, 3C.

Finally, the cut and crushed coupling element pieces 80 remaining on the upper edge of the ejector 32 are cleared in a known manner, for example by means of a blower (not shown). Thus a predetermined length L of element-free space section 83 (Figure 4) has been formed in a pair of continuous slide fastener stringers with no damage to the tapes 82, 82.

Subsequently, as the lower plunger 6 is lowered, the ejector holder 20 is moved downwardly back to the position of Figures 1 and 2 and the pressure pad 12 returns to the position of Figures 1 and 3A, releasing the tapes 82, 82 so that the pair of continuous slide fastener stringers can be fed, for a desired slide fastener length, for a subsequent space-section forming. Preferably, the feeding of the pair of continuous slide fastener stringers may be accomplished automatically by means of a suitable feed device (not shown).

With this arrangement, it is absolutely unnecessary to pull the tapes 82, 82 laterally away from each other during the space-section forming

operation. Accordingly it is possible to form a space section 83 devoid of coupling elements 80 accurately with no damage to the tapes 82, 82, guaranteeing adequate quality slide fastener stringers of concealed

5 type.

Since most main parts are moved simply vertically, the apparatus can be automated easily and can be operated at high speed. Further, the ejector 32, the dies 30, 30 and the pressure pad 12 are moved
10 by only a single actuating member (lower plunger 6), making the apparatus simple in construction and hence inexpensive.

15

20

25



CLAIMS:-

1. A method of forming a space section in a pair of concealed-slide-fastener stringers including a pair of continuous tapes carrying along their folded inner longitudinal edges a pair of rows of interengaged filamentary coupling elements, each coupling element row being attached to the respective folded tape edge by sewn stitches, said method comprising:
- 5 (a) gripping the tapes with the interengaged coupling elements disposed at the upper side of the tapes;
- 10 (b) with the tapes gripped, pushing the fastener stringers upwardly from the under side of the tapes by a pair of laterally spaced and vertically movable dies until head portions of a series of the interengaged coupling elements are exposed to the dies and then supported thereon;
- 15 (c) cutting certain interengaged coupling elements on the dies by a vertically movable punch coactive with the dies; and
- 20 (d) with the tapes gripped, pulling the cut coupling elements out of the sewn stitches by the punch and a vertically movable ejector with the cut coupling elements clamped between the punch and the ejector.
- 25 2. A method according to claim 1, said cutting including severing upper leg portions of the coupling elements by a pair of laterally spaced and elongated

(34)



cutting edges of the punch and pressing the severed coupling elements by the punch against the dies to crush the heads portions of the severed coupling elements.

5 3. An apparatus for forming a space section in a pair of concealed-slide-fastener stringers including a pair of continuous tapes carrying along their folded inner longitudinal edges a pair of rows of interengaged filamentary coupling elements, each coupling element row being
10 attached to the respective folded tape edge by sewn stitches, said apparatus comprising:

(a) a support table having means defining a guide groove receptive of the fastener stringers with the interengaged coupling elements disposed at the
15 upper side of the tapes;

(b) a pair of spaced guide plates mounted on said support table in confronting relation to each other and defining an upper side of said guide groove, said guide plates having along their confronting edges
20 a pair of step portions, respectively, for supporting the interengaged coupling elements together with the folded tape edges;

(c) a pressure pad and a pair of laterally spaced dies disposed in said support table and defining
25 an under side of said guide groove, said pressure pad being vertically movable to grip the tapes against said guide plates, said dies being vertically movable and



25

- 19 -

having a pair of elongated pushing edges projectable into a space between said step portions of said guide plates for pushing the fastener stringers upwardly from the under side of the tapes until head portions of a series of the interengaged coupling elements are exposed to said dies and then supported thereon;

(d) a punch vertically movable toward and away from said step portions of said guide plates for cutting certain interengaged coupling elements supported on said dies;

(e) an ejector vertically movably disposed between said dies and projectable beyond said pushing edges thereof through the space between said step portions of said guide plates for clamping the cut coupling elements against said punch for jointly removing the cut coupling elements clamped therebetween; and

(f) means for actuating said pressure pad, said dies and said ejector in timed relation to one another.

4. An apparatus according to claim 3, said punch having a pair of laterally spaced, elongated cutting edges for severing upper leg portions of the coupling elements.

5. An apparatus according to claim 4, said punch further having an elongated pressing edge disposed centrally between said cutting edges for pressing the head portions of the severed coupling



elements against the dies to crush the head portions.

6. An apparatus according to claim 3, 4 or 5, said pressure pad having on its top surface a pair of parallel elongated lands disposed one at each side of said dies, said guide plates having in their under surfaces a pair of elongated recesses complementary to said lands, respectively.

7. An apparatus according to claim 6, each of said guide plates having an elongated jaw disposed between a respective one of said step portions and a respective one of said recesses.

8. An apparatus according to claim 7, said jaws having a pair of slanted under surfaces converging upwardly.

9. An apparatus according to any one of claims 3 to 8, said actuating means including:

(a) a stationary base disposed under said support table;

(b) a plunger vertically reciprocable in said base;

(c) a slide vertically movably disposed in said support table, said slide being upwardly movable in response to upward movement of said plunger;

(d) a first set of compression springs acting between said support table and said slide to urge the latter downwardly toward said base;

(e) a second set of compression springs acting



- 21 -

between said pressure pad and said base to urge vertically one away from the other;

(f) an ejector holder supporting said ejector and connected to said plunger, said ejector holder
5 being vertically movable, in response to the vertical movement of said plunger, between a projected position in which said ejector projects beyond said pushing edges of said dies through the space between said guide plates and a retracted position in which said ejector
10 is retracted into said dies;

(g) a third set of compression springs acting between said pressure pad and said ejector holder to urge vertically one away from the other;

(h) a die holder supporting said dies and
15 vertically slidably connected to said slide, said die holder being vertically movable, in response to the vertical movement of said slide, between an upper position in which said ejector projects into the space between said step portions of said guide plates and a
20 lower position in which said ejector is retracted into said dies, while said ejector holder is vertically moved between said projected position and said retracted position; and

(i) a fourth set of compression springs acting
25 between said support table and said die holder to urge the latter downwardly toward said base.



10. A method of forming a space section in a pair of concealed-slide-fastener stringers substantially as described with reference to the accompanying drawings.
 11. Apparatus substantially as described with reference to and as illustrated in the accompanying drawings.
-