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METHOD OF AND APPARATUS FOR
BUNDLING ELONGATE ARTICLES

The present invention relates to a method of and an apparatus for automatically bundling elongate articles such as slide fasteners, and more particularly to a method of and an apparatus for bundling a
5 plurality of elongate articles with a bundling band fed to and cut off in a bundling station.

Finished slide fasteners discharged one by one from a slide fastener finishing machine are generally bundled manually by bands, and a number of bundles are
10 packaged in a box. The conventional bundling bands are marked with printed items of information such as slide fastener types, dimensions, colors, and the number of slide fasteners bundled together. Therefore, there have been required many kinds of bundling bands, and it
15 has been quite a complex task to keep an inventory of all necessary types of bundling bands at all times. The bundling bands have to be changed each time slide

fasteners of different kinds, dimensions, and numbers are to be manufactured. The prior bundling practice has also been disadvantageous in that if the bundling bands were not changed or different bands were used, the information printed on the bands would fail to properly indicated the slide fasteners tied up thereby. Furthermore, the manual bundling operation is time-consuming and makes the bundles unsightly as the bands tend to be irregularly positioned.

It is believed possible by means of the present invention to provide a method of bundling elongate articles such as slide fasteners successively, automatically, and uniformly.

It is also believed possible by means of the present invention to provide an apparatus for bundling elongate articles such as slide fasteners successively, automatically, and uniformly.

According to a first aspect of the present invention, there is provided a method of bundling a number of elongate articles with a band, comprising the steps of:

(a) feeding an untensioned length of band web while gripping a free end thereof at a first fixed position, and thereafter holding the web at a second fixed position against further feeding so that said length of the band web takes an untensioned gravity-formed upwardly open U-shape between said first and second fixed positions;

(b) thereafter depositing by gravity a number of elongate articles on said length one-at-a-time;

(c) holding down said elongate articles deposited on said length;

5 (d) causing an opposite end of said fixed length to be juxtaposed at said first fixed position with said free end and gripping said free end and said opposite end of said fixed length together at said first fixed position to cause said length to surround said elongate
10 articles, while simultaneously gripping the prospective free end of the next length of band web at said first fixed position;

(e) fusing only the two end portions of said length to each other while gripping all of said three ends at
15 said first fixed position;

(f) cutting said length off said band web while gripping all of said three ends at said first fixed position;

(g) releasing said free end and said opposite end
20 of said fixed length while maintaining the gripping on the free end of said next length of band web at said first position, thus producing a banded bundle of said elongate articles; and

(h) discharging said elongate articles bundled by
25 said band.

According to a second aspect of the present invention, there is provided an apparatus for bundling a number of elongate articles with a band, comprising:

(a) a bundle tray;

(b) a reel for the band web;

(c) a feed mechanism for supplying a length of the band web from said reel onto said bundle tray;

(d) a discharger for discharging a number of elongate articles one-at-a-time onto said length on said bundle tray;

(e) a gripper mechanism disposed on one side of said bundle tray for gripping a free end of said length;

(f) a presser mechanism disposed substantially in confronting relation to said gripper mechanism and movable over the tray from an opposite side to said one side of said bundle tray for pressing an opposite end of said length into said gripper mechanism so as to be gripped by said gripper mechanism with said length surrounding said elongate articles.

(g) a fusing mechanism for fusing end portions of said length to each other;

(h) a holder mechanism movable over the tray from said opposite side towards said one side of said bundle tray for holding down said elongate articles when said opposite end of said length is gripped by said gripper mechanism; and

(i) a cutter mechanism for cutting said length off said band web at said opposite end of said length as it is gripped by said gripper mechanism, thereby producing a band bundling said elongate articles.

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

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Figure 1 is a perspective view of an apparatus for bundling slide fasteners according to an embodiment of the present invention;

Figures 2A through 2H are schematic views showing pregressive steps of bundling operation of the apparatus illustrated in Figure 1;

Figures 3A and 3B are perspective views of slide fasteners bundled by the apparatus of Figure 1;

Figure 4 is a perspective view of an apparatus for bundling slide fasteners according to another embodiment of the present invention;

Figures 5A through 5H are schematic views showing pregressive steps of bundling operation of the apparatus illustrated in Figure 4;

Figures 6A and 6B are perspective views of slide fasteners bundled by the apparatus of Figure 4;

Figure 7 is an enlarged side elevational view, partly broken away, showing the manner in which a piercing needle operates; and

Figure 8 is a fragmentary perspective view of a cutter according to still another embodiment.

Identical or like parts are denoted by identical

or like reference characters throughout the views.

Figure 1 shows an apparatus for bundling a number of elongate pieces or articles F such as slide fasteners with a bundling band t (Figures 3A and 3B) of
5 synthetic resin such as polyethylene or vinyl chloride, or laminated plastic of paper and synthetic resin, the apparatus being generally designated by the reference numeral 10.

The apparatus 10 has an elongate channel-shaped
10 bundle tray 11 positioned substantially centrally in the apparatus 10 for receiving a bundle of elongate articles F. A reel 12 is rotatably mounted by a shaft 13 on a support (not shown) and positioned upwardly of the bundle tray 11 on one side thereof, the reel 12
15 supporting a roll of continuous band web T from which successive bands are cut off. A feed roller 14 is rotatably mounted by a shaft 14a on a base 15 for feeding the continuous band web T by a predetermined length in each cycle of operation of the bundling
20 apparatus 10, the shaft 14a being coupled to a reversible motor (not shown). The feed roller 14 is positioned substantially directly below the reel 12. A band web guide 16 is vertically angularly movably mounted by a pin 17 on the base 15 below the feed
25 roller 14. The band web guide 16 has a guide groove defined in an upper surface thereof and receiving a lower portion of the feed roller 14 loosely fitted

therein. The guide groove is slightly wider than the band web T for guiding the same therein. The band web guide 16 is normally biased by a spring 18 to move toward the feed roller 14 for coacting therewith in supplying the band web T by a controlled length each time.

A band web presser 19 is disposed below the feed roller 14 for laterally displacing the band web T as supplied from the feed roller 14. The band web presser 19 comprises a horizontal presser arm 20 having a positioning recess 21 defined in a distal end thereof and extending from a vertical base 22 and an anvil 23 positioned below the presser arm 20 and extending from the base 22 parallel to the presser arm 20. There is a horizontal forked band web holder 24 disposed below and extending parallel to the presser arm 20 from a vertical base 26, the band web holder 24 having a rectangular slot 25 defined therein and extending from a distal end thereof toward the base 26 but terminating short thereof. A pair of horizontal pneumatic cylinders 27, 28 is supported on a cylinder support 29 and has a pair of respective piston rods 30, 31 connected respectively to the vertical bases 22, 26 for retractably moving the presser arm 20, the anvil 23, and the band web holder 24 toward a position over the bundle tray 11.

A band web gripper 32 is positioned upwardly of

the bundle tray 11 on an opposite side thereof in confronting relation to the presser arm 20. The band web gripper 32 includes a base 33 and a pair of gripping jaws 34, 35 pivotably mounted on the base 32 by pins 36, 37, respectively. The gripping jaws 34, 35 are normally biased toward each other by a spring 38 connected between the gripping jaws 34, 35 for gripping a free end of the band web T and a portion thereof that has been drawn by the band web presser arm 20, as will be described later. A vertical cutter 39 is vertically movably disposed above a rear end of the band web gripper 32 remote from the pins 36, 37 for cutting off a portion T_1 (Figure 2E) of the band web T which projects from the rear end of the band web gripper 32.

An ultrasonic horn 40 is positioned below the band web gripper 32 in confronting relation to the anvil 23 for fusing the band web T applied thereagainst by the anvil 23 which have moved toward the ultrasonic horn 40. The ultrasonic horn 40 is supported at a rear end thereof by a support arm 41. A horizontal bundle pusher 42 is horizontally movably supported at a rear end thereof on a piston rod 43 of an air cylinder (not shown). The horizontal bundle pusher 42 is retractably movable toward a position over the bundle tray 11.

A printer 44 is positioned between the reel 12 and the feed roller 14 for marking various pieces of information such as a slide fastener type and a lot

number on the bundle web T at spaced intervals therealong.

A pair of hot air nozzles 45, 46 is disposed one on each side of the bundle tray 11 in mutually
5 confronting relation for emitting hot air toward a finished bundle on the bundle tray 11. Where the bundle web T is made of a thermally shrinkable material, a bundle band will shrink around slide
10 fasteners F upon application of hot air for stably and tightly bundling the slide fasteners F.

Operation of the apparatus 10 of the foregoing construction will be described with reference to Figures 2A through 2H.

As shown in Figure 2A, a predetermined length of
15 the band web T is unreeled by the feed roller 14 onto the bundle tray 11 substantially in the shape of a U with its free end gripped by the band web gripper 32. The presser arm 20, the anvil 23, the band web holder 24, and the bundle pusher 42 are in their retracted
20 position as shown.

Finished slide fasteners F are discharged by gravity from a fastener discharger H coupled to a slide fastener finishing machine (not shown) and positioned over the bundle tray 11 so that the slide fasteners F
25 are placed on the band web T on the bundle tray 11, as illustrated in Figure 2B.

The band web holder 24 is moved forward with the

band web T received in the slot 25 (Figure 1) to the position over the bundle tray 11, in which the band web holder 24 hold down the slide fasteners F extending across the band web T, as shown in Figure 2C.

5 Then, the presser arm 20 and the anvil 23 are moved forward. The presser arm 20 presses the band web T as folded forcibly between the gripping jaws 34, 35. At this time, the band web T is prevented by the band web holder 24 from being excessively pulled upwardly.
10 The anvil 23 also presses portions of the band web T as it surrounds the slide fasteners F against the tip end of the ultrasonic horn 40. The ultsonic horn 40 is now energized to fuse the band web T against the anvil 23 (Figure 2D).

15 After the band web T has been ultrasonically fused, the presser arm 20 and the anvil 23 are retracted to their original position. The free end and folded portion of the band web T are left gripped between the gripping jaws 34, 35, with a length of the
20 band web T between the free end and folded portion extending around the slide fasteners F, as shown in Figure 2E.

The cutter 39 is then lowered to cut off a portion T1 of the band web T which projects from the
25 rear end of the band web gripper 32, whereupon the length of the band web T disposed around the slide fasteners F is cut off from the band web T into a

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bundling band t as shown in Figure 2F.

The band web holder 24 is retracted and at the same time the bundle pusher 42 is moved forward to push the bundling band t so that its end will be pulled off
5 the band web gripper 32. At this time, an end of the band web T as supplied from the feed roller 14 remains gripped by the band web gripper 32. In case the band web T is made of a thermally shrinkable material, hot air is discharged from the hot air nozzles 45, 46
10 against the bundling band t to cause the latter to shrink tightly around the slide fasteners F, thereby producing a bundled article p, as illustrated in Figure 2G.

Finally the bundle tray 11 is tilted about one
15 of its longitudinal edge to discharge the bundled article p as shown in Figure 2H.

One cycle of bundling operation is now completed. The above cycle is then repeated to produce successive bundles of slide fasteners F. The printer
20 44 is actuated to mark the band web T with necessary information in each bundling cycle.

Figure 3A shows a bundled article p thus produced from the apparatus 10. The bundled slide fasteners F are bundled by the band t bearing a printed
25 piece of information L indicating a lot number. Figure 3B illustrates another bundled article p in which the slide fasteners F are bundled by two bands t which can

be supplied by two of the apparatus 10 which are disposed side by side.

Figure 4 illustrates a bundling apparatus 50 according to another embodiment of the present invention. The apparatus 50 is basically the same as the apparatus 10 shown in Figure 1, and only those components which differ from those of the apparatus 10 will be described below.

The bundle tray 11 and the slide fastener discharger H are vertically spaced from each other with a bundling station S defined therebetween.

The reel 12 for supplying the band web T and the printer 44 are mounted on a base 15a. The feed roller 14 and the band web guide 16 jointly constitute a band web feed mechanism A.

A band web presser mechanism B disposed below the feed roller 14 comprises a horizontal presser arm 51 having a horizontal slit 52 defined in a distal end thereof. An anvil 53 is positioned below the presser arm 51. The anvil 53 and the ultrasonic horn 40 jointly constitute a band fusing mechanism C. A band web holder mechanism D comprises a horizontal forked band web holder 54 located downwardly of the anvil 53 and has a slot 55. The apparatus 50 further includes a support 56 supporting thereon three parallel air cylinders 57, 58, 59 which have respective piston rods 60, 61, 62 connected respectively to the presser arm

51, the anvil 53, and the band web holder 54.

A band web gripper E is composed of the gripping jaws 34, 35 having apertures 63, 64 (Figure 7) defined vertically therethrough. A piercing needle 65 is
5 located above the band web gripper E in vertical alignment with the apertures 63, 64. The piercing needle 65 is vertically movable by an air cylinder 66.

A cutter mechanism G is located behind the band web gripper E and comprises a horizontal cutter 67
10 mounted on a piston rod 68 of an air cylinder 69. The cutter 67 is retractably movable toward the band web gripper E and into the slit 52 in the presser arm 51 as it is positioned between the gripping jaws 34, 35, as will be described later.

15 Figures 5A through 5H illustrate progressive steps of bundling operation of the apparatus 50. The steps shown in Figures 5A through 5H are substantially the same as those illustrated in Figures 2A through 2H.

Only those operation modes which are different from
20 the operation of Figures 2A through 2H will be described. After the band web T is pressed by the presser arm 51 into a position between the gripping jaws 34, 35 as shown in Figure 5D, the horizontal cutter 67 is moved into the slit 52 in the presser arm
25 51, cutting into the folded portion of the band web T, as illustrated in Figure 5E. The horizontal cutter 67 is more advantageous than the vertical cutter 39

(Figure 1) in that there is no waste band web portion cut off. As shown in Figures 5E, 5F, and 7, the gripper E now grips an end T" of the band web T as supplied from the feed roller 14 and ends T' of a bundling band t.

The piercing needle 65 is actuated by the air cylinder 66 at the time one sequence of bundling cycles is completed, or upon a shortage of slide fasteners F to be bundled together at the time a different number of slide fasteners are to be tied by one band or a different type of slide fasteners is to be bundled. More specifically, when there is a shortage of slide fasteners F to be bundled together by one band, the piercing needle 65 is lowered all the way through the apertures 63, 64 in the gripping jaws 34, 35 to form holes I (Figure 6A) in the ends T' of the band t, thus indicating such a slide fastener shortage. After the piercing needle 65 has been lifted and the bundled article p has been discharged, the pierced end T" of the band web T remains gripped between the gripping jaws 34, 35. Since the piercing needle 65 is not actuated if there is a sufficient number of slide fasteners supplied, a next bundled article p has a band t having only one hole I in one of the ends thereof, as shown in Figure 6B. Therefore, the band t with one pierced hole only can be distinguished from the band which bundles an insufficient number of slide

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fasteners. The piercing needle 65 is preferably put into operation in the step shown in Figure 5F.

The band web feed mechanism A, the band web presser mechanisms B, the fusing mechanism C, the band web holder mechanism D, and the cutter mechanism G are driven by different drive sources so that the mechanisms can be adjusted separately to achieve a desired operation sequence. Therefore, band webs and slide fasteners of different types and dimensions can be used on the apparatus 50.

Figure 8 shows a cutter mechanism according to still another embodiment of the invention. The cutter mechanism includes a cutter 70 drivable by an air cylinder 71 to move in a direction substantially perpendicularly to the direction in which the presser arm 51 is retractably movable. The cutter 70 transversely cuts off the folded band web portion projecting from the gripping jaws 34, 35. The cutter mechanism of Figure 8 also does not produce any waste band web.



Claims:

1. A method of bundling a number of elongate articles with a band, comprising the steps of:

5 (a) feeding an untensioned length of band web while gripping a free end thereof at a first fixed position, and thereafter holding the web at a second fixed position against further feeding so that said length of the band web takes an untensioned gravity-formed upwardly open U-shape between said first and second
10 fixed positions;

(b) thereafter depositing by gravity a number of elongate articles on said length one-at-a-time;

(c) holding down said elongate articles deposited on said length;

15 (d) causing an opposite end of said fixed length to be juxtaposed at said first fixed position with said free end and gripping said free end and said opposite end of said fixed length together at said first fixed position to cause said length to surround said elongate
20 articles, while simultaneously gripping the prospective free end of the next length of band web at said first fixed position;

(e) fusing only the two end portions of said length to each other while gripping all of said three ends at
25 said first fixed position;

(f) cutting said length off said band web while gripping all of said three ends at said first fixed



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position;

(g) releasing said free end and said opposite end of said fixed length while maintaining the gripping on the free end of said next length of band web at said first position, thus producing a banded bundle of said elongate articles; and

(h) discharging said elongate articles bundled by said band.

2. A method according to claim 1, wherein the band web is made of thermally shrinkable material and including the step of thermally shrinking said fused band tightly around said elongate article before they are discharged.

3. A method according to claim 1, including the step of selectively piercing said free end and said opposite end.

4. A method according to claim 1, wherein said end portions of said length are ultrasonically fused together.

5. An apparatus for bundling a number of elongate articles with a band, comprising:

(a) a bundle tray;

(b) a reel for the band web;

(c) a feed mechanism for supplying a length of the band web from said reel onto said bundle tray;

(d) a discharger for discharging a number of elongate articles one-at-a-time onto said length on said bundle tray;



(e) a gripper mechanism disposed on one side of said bundle tray for gripping a free end of said length;

(f) a presser mechanism disposed substantially in confronting relation to said gripper mechanism and movable over the tray from an opposite side to said one side of said bundle tray for pressing an opposite end of said length into said gripper mechanism so as to be gripped by said gripper mechanism with said length surrounding said elongate articles,

(g) a fusing mechanism for fusing end portions of said length to each other;

(h) a holder mechanism movable over the tray from said opposite side towards said one side of said bundle tray for holding down said elongate articles when said opposite end of said length is gripped by said gripper mechanism; and

(i) a cutter mechanism for cutting said length off said band web at said opposite end of said length as it is gripped by said gripper mechanism, thereby producing a band bundling said elongate articles.

6. An apparatus according to claim 5, including a base, said feed mechanism comprising a motor-driven roller rotatably mounted on said base, a guide pivotably mounted on said base and having a guide groove for guiding said band web therein; and a spring for normally urging said guide toward said roller.

7. An apparatus according to claim 5, wherein said gripper mechanism comprises a pair of gripping jaws for



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gripping said free end of the band web therebetween, and said presser mechanism comprises a presser arm, said presser arm being movable towards and receivable between said gripping jaws, thereby inserting said opposite end of said band web therebetween.

8. An apparatus according to claim 7, said presser arm having a slit defined in a distal end thereof, said cutter mechanism including a cutter reciprocally movable into said slit when said presser arm is received between said gripping jaws.

9. An apparatus according to any one of claims 5 to 8, wherein said fusing mechanism comprises an ultrasonic horn and an anvil disposed respectively below said gripper mechanism and said presser mechanism and relatively movable toward and away from each other to press said end portions of said length therebetween.

10. An apparatus according to claim 9, wherein said ultrasonic horn is fixed, said anvil being movable toward and away from said ultrasonic horn to press said end portions of said length against said ultrasonic horn.

11. An apparatus according to any one of claims 5 to 10, wherein said holder mechanism comprises a holder having a slot for receiving said length of the band web therein.

12. An apparatus according to any one of claims 5 to 11, wherein said cutter mechanism comprises a vertical cutter for transversely cutting off said opposite end of said length as it projects from said gripper mechanism.



13. An apparatus according to any one of claims 5 to 12, wherein said cutter mechanism comprises a horizontal cutter for longitudinally cutting off said opposite end of said length as it projects from said gripper mechanism.

14. An apparatus according to any one of claims 5 to 13, further including a pusher for pushing said band off said gripper mechanism.

15. An apparatus according to any one of claims 5 to 14, further including means for thermally shrinking said band tightly around said elongate articles.

16. An apparatus according to claim 15, wherein said means comprises a pair of hot air nozzles disposed one on each side of said bundle tray for applying hot air against said band.

17. An apparatus according to any one of claims 5 to 16, further including means for selectively piercing said free end and said opposite end.

18. An apparatus according to claim 17, wherein said gripper mechanism comprises a pair of gripping jaws for gripping said free end and said opposite end of the band web therebetween, said gripping jaws having a pair of apertures respectively therein, said means comprising a piercing needle movable through said apertures for piercing said free and said opposite end.

19. A method substantially as described with reference to Figures 1, 2A, through 2H, 3A and 3B of the accompanying drawings.



20. An apparatus substantially as described with reference to and as illustrated in Figures 1, 2A through 2H, 3A and 3B of the accompanying drawings.

21. A method substantially as described with reference to Figures 4, 5A through 5H, 6A and 7 of the accompanying drawings.

22. An apparatus substantially as described with reference to and as illustrated in Figures 4, 5A through 5H, 6A and ~~6B~~⁷ of the accompanying drawings.

23. A method as claimed in claim ~~19~~ or ~~21~~ modified as described with reference to Figure 8 of the accompanying drawings.

24. An apparatus as claimed in claim ~~20~~ or ~~22~~ modified as described with reference to and as illustrated in Figure 8 of the accompanying drawings.
