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"METHOD OF AND APPARATUS FOR MANUFACTURING SLIDE
FASTENER COUPLING ELEMENTS"

The present invention relates to the production of slide fastener stringers, and more particularly to a method of and apparatus for manufacturing slide fastener coupling elements of metal suitable for use with a two-way slide fastener.

A two-way slide fastener has a pair of oppositely disposed sliders and hence can be opened from either end. To facilitate smooth movement of the sliders in either direction, it is required to chamfer the coupling heads of metallic coupling elements on one face of each coupling head. Such ^{has been} chamfering ~~is~~ hitherto performed by means of a separate, small-sized cutting tool, which not only has a short endurance, but also often causes production of burrs and chips. Further, with the small-sized cutting tool, it is difficult to produce adequate quality of coupling elements.

According to one aspect of the invention, there is provided ^{a method} of manufacturing coupling elements for a slide fastener, comprising the steps of: providing a rod of metal of a generally Y-shaped cross section having a base, as a prospective coupling head, and a pair of legs divergently extending from the base; feeding the rod stepwise in a longitudinal direction; transversely slicing the rod into a plurality of coupling element blanks in timed relation to said stepwise feeding; placing the coupling element blanks, one at a time, in a coupling-head forming station away from the rod in a direction

perpendicular to said longitudinal direction; and at the coupling-head forming station, forming the base^{of} each coupling element blank into a final coupling head of one coupling element which head has a projection from one face and a coacting socket in the other face; CHARACTERIZED IN ^{THAT} ~~that~~ said method comprises the further step of forming a chamfered portion on the base of the rod every time each coupling element blank is sliced off from the rod and then placed in the coupling-head forming station, each coupling element blank thus having the chamfered base; ^{AND IN THAT} ~~and that~~ the first-named forming step is effected in such a manner that the chamfered portion is disposed around the socket.

According to another aspect of the invention, there is provided an apparatus for manufacturing coupling elements for a slide fastener from a rod of metal of a generally Y-shaped cross-section having a base *, as a prospective coupling head, and a pair of legs divergently extending from the base, said apparatus comprising: means for feeding the rod in a longitudinal direction in regular steps of a predetermined distance equal to the thickness of one coupling element; a fixed cutting punch having a cutting edge; a reciprocating ram movable relatively to said cutting punch perpendicularly to said longitudinal direction; a cutting die carried by said ram and having a hole for the passage of the rod, said cutting die being movable, in response to the reciprocating movement of said ram, across a cutting edge of said cutting punch for transversely slicing the rod into a plurality of coupling element blanks, one on each stroke of said ram; a forming die carried by said ram and movable, in response to the reciprocating movement of said ram, toward and away from said cutting edge

of said cutting punch at one end of each stroke of said ram; and a forming punch movable toward said forming die for forming the base of each coupling element blank into a final coupling head of one coupling element which head has a projection from one face and a coacting socket in the other face; CHARACTERIZED ^{THAT} IN ~~that~~ said fixed cutting punch has a projection, said ram having a channel in which said projection of said cutting punch is slidably received and which communicates with said hole at one end thereof; means, disposed on said projection of said cutting punch, for forming a chamfered portion on the base of the rod at one end of each stroke of said ram, each coupling element blank thus having the chamfered base; ^{AND IN THAT} ~~and that~~ said forming die and punch are effective to form the socket in such a manner that the chamfered portion is disposed around the socket.

~~It is therefore an object of the invention to provide a method of manufacturing high quality of metallic coupling elements suitable for two-way slide fasteners.~~

Another object of the invention is to provide a method of manufacturing accurate coupling elements, for two-way slide fasteners, with improved rate of production.

Still another object of the invention is to provide an apparatus for carrying out the method described above, which not only requires no additional parts, but also has ~~an improved endurance.~~

The invention will be described by way of example with ~~Other objects and advantages will appear from the following reference to the accompanying drawings, wherein:-~~
~~ing description of an example of the invention, when considered in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.~~

FIG. 1 is a fragmentary perspective view of an apparatus according to a first embodiment of the present invention;

FIG. 2 is a longitudinal cross-sectional view taken along line II - II of FIG. 1, showing the parts in a starting position for the manufacture of a coupling element;

FIGS. 3 through 5 are cross-sectional views similar to FIG. 2, each showing a different stage of the manufacture;

FIG. 6 is a fragmentary perspective view similar to FIG. 1, but showing a second embodiment, with parts broken away;

FIG. 7 is a longitudinal cross-sectional view taken along line VII - VII of FIG. 6, showing the parts in a starting position for the manufacture of a coupling element;

FIGS. 8 through 10 are similar to FIG. 7, each showing a different stage of the manufacture;

FIG. 11 is a cross-sectional view similar to FIG. 9, but showing a third embodiment, with parts omitted;

FIG. 12 is a fragmentary plan view of a two-way slide fastener having coupling elements manufactured according to the present invention; and

FIGS. 13 and 14 are enlarged perspective views of different kinds of coupling elements manufactured according to the present invention and suitable for use with a two-way slide fastener.

Like reference numerals designate similar parts throughout the several views.

FIG. 1 shows an apparatus 1 for manufacturing coupling elements 2', for a slide fastener and more particularly for a two-way slide fastener 3 (FIG. 12), from a rod 4 of metal

of a generally Y-shaped cross section having a base 5, as a prospective coupling head 5" (FIGS. 2, 13 and 14), and a pair of legs 6,6 divergently extending from the base 5.

5 The apparatus 1 generally comprises a pair of rollers 7,8 for feeding the rod 4 stepwise upwardly, i.e. in a longitudinal direction indicated by an arrow 9, in regular steps of a distance h (FIG.2) equal to the thickness of a single coupling element 2', a coacting cutting die and
10 punch 10,11 for transversely slicing the rod 4 into a plurality of coupling elements blanks 2 (only one shown in FIGS.3 and 4) in timed relation to the stepwise feeding of the rod 4, and a coacting forming die and punch 12,13
15 for forming a slice of coupling element blank 2 into a final coupling element 2'.

 The cutting punch 11, which is stationary, has at its forward end a cutting edge 14. The cutting die 10, which is carried by a reciprocating ram 15 at its forward end, has a vertical hole 16 for the passage of the rod 4. The ram 15 has a horizontal channel 17 in which a
20 projection 18 of the cutting punch 11 is slidably received and which leads to the upper end of the hole 16 of the cutting die 10. Thus the cutting die 10 is movable back and forth, in response to the reciprocating movement of the ram 15, across the cutting edge 14 of the cutting
25 punch 11 for transversely slicing the rod 4 into the individual coupling element blanks 2 one on each backward stroke of the movement of the ram 15.

The apparatus 1 also includes a means, disposed on the projection 18 of the cutting punch 11, for forming (by cold pressing) a chamfered portion 20 on the base 5 of the rod 4 at the end of each backward stroke of the ram 15, so that each coupling

element blank 2 has the chamfered base 5' (FIGS. 3 and 4). The chamfered-portion forming means comprises a chamfering surface 21 composed of a pair of first and second beveled surfaces 21a, 21b for being forced against the base 5 of the rod 4 at the end of each backward stroke of the ram 15. Thus the chamfered portion 20 on the base 5 of the rod 4 is composed of a pair of third and fourth beveled surfaces 20a, 20b corresponding to the first and second beveled surfaces 21a, 21b on the cutting punch 11. As shown in FIG. 4, the fourth beveled surface 20b extends at an angle α with respect to a vertical outer side surface 23 of the rod 4, while the third beveled surface 20a extends at an angle β with respect to a horizontal upper end surface 4a of the rod 4.

The chamfering surface 21 is disposed at a corner defined by the projection 18 and a horizontal surface 24. The horizontal surface 24 is disposed at a level above the bottom surface 25 of the projection 18 by a distance H (FIG. 2). The upper horizontal surface 26 of the cutting die 10, which includes a cutting edge 27, is disposed at a level above the bed 17a of the channel 17 of the ram 15 by the same distance H. Thus as the projection 18 of the cutting punch 11 slides on the bed 17a of the channel 17 of the ram 15, the horizontal surface 24 of the cutting punch 11 slides on the upper horizontal surface 26 of the cutting die 10, during which time the cutting edges 27, 14 of the cutting die and punch 10, 11 are moved relatively to each other.

The forming die 12, contiguous to the cutting die 10, is carried by the ram 15 and is movable, in response to the reciprocating movement of the ram 15, toward and away from the

cutting edge 14 of the cutting punch 11 for receiving one coupling element blank 2 in a coupling-head forming recess 28 at the end of each backward stroke of the movement of the ram 15.

At the end of backward stroke of the ram 15 (FIGS. 4 and 5), the forming recess 28 is in vertical alignment with the forming punch 13 which is movable vertically toward and away from the recess 23, i.e. in directions indicated by arrows 36, 37 (FIG. 1). As the forming punch 13 is lowered to press the coupling element blank 2 at the chamfered base 5', the latter is formed into a final coupling head 5" (FIGS. 2, 13 and 14) having a projection 30 from the lower face and a coacting socket 31 in the upper face at such a position that the beveled surfaces 20a, 20b are disposed around the socket 31. At that time, the coupling element blank 2 is retained in the recess 28 by a presser 32 lowered together with the forming punch 13. Thus a complete coupling element 2' has been produced (FIGS. 2 and 5).

At the end of forward stroke of the ram 15 (FIGS. 1 and 2), a freshly completed coupling element 2' is located adjacent to a slide fastener stringer tape 33 with the legs 6, 6 disposed astride the beaded tape edge 34. A pair of pressing levers 35, 35 (FIG. 1) is moved toward each other to clinch the opposite legs 6, 6 about the beaded edge 34 of the tape 33, which is fed upwardly in steps of a predetermined distance equal to the element-to-element pitch.

In operation, when the ram 15 is moved backwardly, i.e. leftwardly in FIG. 2, the cutting die 10 is moved in the same direction to force the rod 4 to move across the

cutting edge 14 of the fixed cutting punch 11, whereby the upper end portion of the rod 4 which projects out of the hole 16 is sliced off into a coupling element blank 2 (FIG. 3). The rod 4 is fed stepwise upwardly so that it projects from the cutting edge 27 of the cutting die 10 by a length h (FIG. 2) at a time in order that the sliced coupling element blank 2 will have a thickness equal to the length h .

With continued backward movement of the ram 15, the sliced coupling element blank 2 slides on the horizontal upper surface 26 of the cutting die 10 and then on the horizontal upper surface 12a of the forming die 12, as shown in FIG. 3, until the coupling-head forming recess 28 is vertically aligned with both the sliced coupling element blank 2 and the forming punch 13 (FIG. 4). During that time the rod 4 is moved leftwardly and, at the end of the backward stroke of the ram 15, the rod 4 is forced, at portions adjacent to the freshly cut end, against the chamfering surface 21 on the projection 18 of the cutting punch 11. Thus a pair of beveled surfaces 20a, 20b corresponding to the beveled surfaces 21a, 21b of the chamfering surface 21 has been formed on the base 5 of the rod 4 so that a succeeding coupling element blank 2 will have the chamfered base 5'. The preceding coupling element blank 2 had been provided at the base 5' with the same chamfered portion 21 in the same manner.

The forming punch 13 is lowered to press the coupling element blank 2 at the chamfered base 5' to thereby form the latter into a final coupling head 5" (FIGS. 2, 13 and 14) having a projection 30 from the lower face and a coating

socket 31 in the upper face at such a position that the beveled surfaces 20a, 20b are disposed around the socket 31. At that time the coupling element blank 2 is retained in the recess 28 by the presser 32 lowered together with the forming punch 13. Thus a complete coupling element 2' has been produced (FIGS. 2 and 5). Then, the forming punch 13 and the presser 32 are retracted upwardly and, at the same time, the ram 15 is moved forwardly from the retracted position (FIGS. 4 and 5) to the advanced position (FIG. 2) in which the opposite legs 6, 6 of the coupling element blank 2 in the recess 28 are disposed astride the beaded edge 34 of the stringer tape 33.

Finally, the opposite legs 6, 6 of the coupling element blank 2 are clinched by the pair of pressing levers 35, 35 about the beaded edge 34 of the tape 33 which is held at rest between intermittent movements thereof.

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~~According to the present invention, a~~ chamfered portion is formed on the base of the rod in order that the base of the individual coupling element blank will have had such chamfered portion before the formation of a projection and a coacting socket, and for this reason, it is possible to form a chamfered portion accurately and reliably, thus producing high quality of coupling elements suitable for a two-way slide fastener (FIG. 12).

Since the slicing step and the placing step and the chamfered-portion forming step are performed in sequence on only a single stroke of relative movement of the cutting die and punch, it is possible to manufacture accurate coupling elements with improved rate of production.

Further, the apparatus 1 is very simple in construction and hence can be obtained from the conventional apparatus by providing the cutting die with a horizontal channel behind the vertical hole and by providing the cutting punch with a chamfering surface, which requires no complicated machining or added parts.

FIGS. 6 through 10 show a modified apparatus 40 according to a second embodiment similar to the apparatus 1 of FIGS. 1 through 5, and the only difference therefrom is as follows. The chamfering surface 21 on the projection 18 of the cutting punch 11 is disposed below a corner 41 (described below) by a distance h (FIG. 7) equal to the thickness of a single coupling element 2', the corner 41 being defined by the projection 18 and the horizontal surface 24. The chamfering surface 21 comprises a beveled surface of a nose 42 extending forwardly from the projection 18.

When the ram 15 is moved backwardly, i.e. leftwardly in FIG. 7, the cutting die 10 is moved in the same direction to force the rod 4 to move across the cutting edge 14 of the fixed cutting punch 11, whereby the upper end portion of the rod 4 which projects out of the hole 16 is sliced off into a coupling element blank 2 (FIG. 8). The rod 4 is fed stepwise upwardly so that it projects from the cutting edge 27 of the cutting die 10 by a length h (FIG. 7) at a time in order that the sliced coupling element blank 2 will have a thickness equal to the length h .

With continued backward movement of the ram, the sliced coupling element 2 slides on the horizontal upper surface 36 of the forming die 12, as shown in FIG. 8, until the coupling

head forming recess 28 is vertically aligned with both the sliced coupling element blank 2 and the forming punch 13 (FIG. 9). During that time the rod is moved leftwardly and, at the end of the backward stroke of the ram 15, the rod 4 is forced, at a portion below the freshly cut end, against the nose 42 on the projection 18 of the cutting punch 11. The nose 42 bites into the base 5 of the rod 4. Thus a beveled surface 20 corresponding to the chamfering surface 21 has been formed on the base 5 of the rod 4 so that next to next coupling element blank 2 will have the chamfered base 5'. The preceding coupling element blank 2 had been provided at the base 5' with the same chamfered portion 20' in the same manner. The next coupling element blank 2 will have the chamfered portion 20 which had been formed on the previous backward stroke of the ram 15.

The forming punch 13 is lowered to press the coupling element blank 2 at the chamfered base 5' to thereby form the latter into a final coupling head 5" (FIGS. 7, 10, 13 and 14) having a projection 30 from the lower face and a coacting socket 31 in the upper face at such a position that the beveled surface 20 is disposed around the socket 31. At that time the coupling element blank 2 is retained in the recess 28 by the presser 32 lowered together with the forming punch 13. Thus a complete coupling element 2' has been produced (FIGS. 7 and 10). Then, the forming punch 13 and the presser 32 are retracted upwardly and, at the same time, the ram 15 is moved forwardly from the retracted position (FIGS. 9 and 10) to the advanced position (FIG. 7) in which the opposite legs 6,6 of the coupling element blank 2 in the recess 28 are disposed astride the beaded

edge 34 of the stringer tape 33.

Finally, the opposite legs 6,6 of the coupling element blank 2 are clinched by the pair of pressing levers 35,35 about the beaded edge 34 of the tape 33 which is held at rest between intermittent movements thereof.

FIG. 11 is a fragmentary cross-sectional view showing a third embodiment similar to the embodiments of FIGS. 6 through 10, and the only difference therefrom is that the chamfered-portion forming means further includes an auxiliary chamfering surface 43 disposed below the chamfering surface 21 by a distance h (FIG. 2) equal to the thickness of one coupling element. The auxiliary chamfering surface 43 comprises a beveled surface of a small nose 44. The nose 44 bites into the base 5 of the rod 4 when the latter is forced against the projection 18 of the cutting punch 11 at the end of backward stroke of the ram 15. Thus in addition to the beveled surface 20 corresponding to the chamfering surface 21, a beveled surface 45 corresponding to the auxiliary chamfering surface 43 is formed on the base 5 of the rod 4. The beveled surface 45 is disposed below the beveled surface 20 by the distance h equal to the thickness of one coupling element 2' and hence facilitates the formation of the beveled surface 20 on the next backward stroke of the ram 15.

It will be understood that various changes in the details, material, and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.



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CLAIMS:

1. A method of manufacturing coupling elements (2') for a slide fastener (3), comprising the steps of: providing a rod (4) of metal of a generally Y-shaped cross section having a base (5), as a prospective coupling head, and a pair of legs (6,6) divergently extending from the base (4); feeding the rod (4) stepwise in a longitudinal direction; transversely slicing the rod (4) into a plurality of coupling element blanks (2) in timed relation to said stepwise feeding; placing the coupling element blanks (2), one at a time, in a coupling-head forming station away from the rod in a direction perpendicular to said longitudinal direction; and at the coupling-head forming station, forming the base 5' of each coupling element blank (2) into a final coupling head (5") of one coupling element (2') which head has a projection (30) from one face and a coacting socket (31) in the other face;

CHARACTERIZED IN: that said method comprises the further step of forming a chamfered portion (20) on the base (5) of the rod (4) every time each coupling element blank (2) is sliced off from the rod (4) and then placed in the coupling-head forming station, each coupling element blank (2) thus having the chamfered base (5'); and that the first-named forming step is effected in such a manner that the chamfered portion (20) is disposed around the socket (31).

2. A method according to claim 1, said slicing step and said placing step and said chamfered-portion forming step being performed in sequence on each stroke of relative movement of a coacting cutting die (10) and punch (11).



3. A method according to claim 2, said chamfered-portion forming step being performed at one end of each said stroke of the cutting die (10) and punch (11).

4. A method according to claim 1, said chamfered-portion forming being effected by cold pressing.

5. An apparatus for manufacturing coupling elements (2') for a slide fastener (3) from a rod (4) of metal of a generally Y-shaped cross-section having a base (5), as a prospective coupling head, and a pair of legs (6,6) divergently extending from the base (5), said apparatus comprising: means (7,8) for feeding the rod (4) in a longitudinal direction in regular steps of a predetermined distance (h) equal to the thickness of one coupling element (2'); a fixed cutting punch (11) having a cutting edge (14); a reciprocating ram (15) movable relatively to said cutting punch (11) perpendicularly to said longitudinal direction; a cutting die (10) carried by said ram (15) and having a hole (16) for the passage of the rod, said cutting die (10) being movable, in response to the reciprocating movement of said ram (15), across a cutting edge (14) of said cutting punch for transversely slicing the rod (4) into a plurality of coupling element blanks (2), one on each stroke of said ram (15); a forming die (12) carried by said ram (15) and movable, in response to the reciprocating movement of said ram (15), toward and away from said cutting edge (14) of said cutting punch (11) at one end of each stroke of said ram (15); and a forming punch (13) movable toward said forming die (12) for forming the base (5') of each coupling element blank (2) into a final coupling head (5'') of one coupling



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element (2') which head has a projection (30) from one face and a coacting socket (31) in the other face; CHARACTERIZED IN THAT said fixed cutting punch (11) has a projection (18), said ram (15) having a channel (17) in which said projection (18) of said cutting punch (11) is slidably received and which communicates with said hole at one end thereof; IN THAT means (21) is disposed on said projection (18) of said cutting punch (11), for forming a chamfered portion (20) on the base (5) of the rod (4) at one ^{end} of each stroke of said ram (15), each coupling element blank (2) thus having the chamfered base (5'); AND IN THAT said forming die and punch (12,13) are effective to form the socket (31) in such a manner that the chamfered portion (20) is disposed around the socket (31).

6. An apparatus according to claim 5, said chamfered portion forming means including a chamfering surface (21) for being forced against the base (5) of the rod (4) at one end of said ram (15).

7. An apparatus according to claim 6, said chamfering surface (21) being disposed at a first level immediately below said cutting edge (14) of said cutting punch (11).

8. An apparatus according to claim 6, an auxiliary chamfering surface (43) being disposed at a second level below said cutting edge (14) of said cutting punch (11) by a distance equal to $\underline{n}$ times the thickness of one coupling element (2'), where $\underline{n}$ represents a natural

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number.

9. An apparatus according to claim 8, said
chamfered- portion forming means (21) including an
auxiliary chamfering surface (43) disposed below said
5 chamfering surface (21) by



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a distance h equal to the thickness of one coupling element
(2').
