

- 1 -

METHOD OF MANUFACTURING SLIDE FASTENER
STRINGERS WITH PARTI-COLORED ROWS OF
INJECTION-MOLDED COUPLING ELEMENTS

5 The present invention relates to a method of manufacturing a slide fastener stringer having a parti-colored row of injection-molded coupling elements secured to one longitudinal edge of a stringer tape.

Slide fasteners having parti-colored rows of
10 coupling elements are particularly suitable for use with an article, such as garment, having multicolored design patterns as an attractive color coordination or harmony is provided between the coupling elements and the article. Such slide fasteners are usually
15 manufactured by an injection-molding machine of the type which comprises a plurality of juxtaposed injection cylinders respectively held in fluid communication with successive rows of mold cavities in a mold assembly for injecting melt synthetic resin
20 materials of different colors into the corresponding rows of mold cavities at once while the mold assembly is fully closed with a stringer tape held herein, thereby forming a parti-colored row of injection-molded coupling elements secured to the stringer tape along
25 one longitudinal edge thereof.

The conventional practice is however disadvantageous in that complicated control is

necessary in maintaining various molding factors, such as heating temperature, injection pressure and injection quantity, in a uniform condition over all the injection cylinders. Furthermore, it becomes difficult
5 to maintain the desired molding condition when injection-molding a parti-colored row of coupling elements in which respective coupling element groups of different colors are not uniform in length. Another drawback is in that due to the large number of
10 injection cylinders, the injection-molding machine as a whole becomes large in size and complicated in construction.

According to the present invention, there is provided a method of manufacturing a slide fastener
15 stringer to include a stringer tape and a parti-colored row of injection molded coupling elements secured to the stringer tape along a longitudinal edge thereof, said method comprising the steps of:

(a) injection-molding a plurality of
20 longitudinally spaced rows of coupling elements on a stringer tape along a longitudinal edge thereof, the rows of injection-molded coupling elements having a first color and being spaced from one another by a plurality of element-free portions;

25 (b) injection-molding a plurality of longitudinally spaced rows of coupling elements on the

stringer tape along the respective element-free portions, the just injection-molded rows of coupling elements having a second color which is different from the first color of the previous injection-molded coupling elements; and

(c) repeating the above-mentioned step (b) until the element-free portions are occupied with the injection-molded coupling elements.

It is believed possible by means of the present invention to provide a method which will eliminate and substantially overcome the foregoing drawbacks of the prior method.

It is further believed possible by means of the present invention to provide a method applicable to an injection-molding machine of the type having a single injection cylinder, for manufacturing a slide fastener stringer having a parti-colored row of coupling elements injection-molded on a stringer tape along one longitudinal edge thereof.

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

Figures 1A through 1C are fragmentary plan views of a pair of slide fastener stringers, illustrative of successive molding steps for forming a pair of part-colored rows of injection-molded coupling

elements on the fastener stringers according to the present invention;

Figure 2 is a fragmentary plan view of a slide fastener including the fastener stringers manufactured
5 in accordance with the present invention;

Figure 3 is a fragmentary perspective view of a mold assembly used to manufacture the fastener stringers of Figure 2;

Figures 4A through 4C are views similar to
10 Figures 1A to 1C, but showing a modified molding process applicable to another mold assembly;

Figure 5 is a schematic fragmentary plan view of a pair of slide fastener stringers having opposed parti-colored rows of injection-molded coupling
15 elements of two different color groups;

Figure 6 is a view similar to Figure 5, showing parti-colored rows of injection-molded coupling elements composed of four different color groups;

Figures 7 through 9 are schematic fragmentary
20 plan views of various slide fastener stringers each having a parti-colored row of injection-molded coupling elements in which respective colored coupling element groups have different lengths;

Figure 10 is a schematic fragmentary plan view
25 of two identical fastener stringers interconnected in a longitudinally displaced relation to one another so as to provide a staggered color pattern on opposed

parti-colored rows of coupling elements; and

Figure 11, appearing with Figure 2, is a perspective view of a mold member having a control rod for adjusting the length of a row of coupling elements to be injection-molded.

Figures 1A through 1C show successive molding steps embodying the present invention for manufacturing a pair of slide fastener stringers S, S each including a multicolored or parti-colored row of injection-molded coupling elements secured to a stringer tape T along one longitudinal edge thereof. The coupling elements are composed of three successive groups E1, E2, E3 of different individual colors, each colored coupling element group including a plurality of rows of coupling elements longitudinally spaced at equal intervals. The slide fastener stringers S, S thus manufactured are coupled together to form a slide fastener shown in Figure 2.

The slide fastener stringers S, S are manufactured by an injection-molding machine including a mold assembly M such as shown in Figure 3. The mold assembly M includes a pair of upper and lower mold halves or members M2, M1 relatively movable toward each other to define therebetween a plurality of rows of mold cavities longitudinally spaced at equal intervals and held in fluid communication with one another. Each of the mold members M1, M2 has in its mold surface a

pair of laterally spaced rows of mold cavities 1, each row being composed of a plurality of mold cavity groups (two being shown in Figure 3) longitudinally spaced from one another by elongate lands 2. Each mold cavity group has a length equal to the length of each row of injection-molded coupling elements E1, E2, E3 of one color. The mold member M1, M2 also includes a runner 3 disposed between and extending longitudinally along the rows of mold cavities, the runner 3 being held in fluid communication with the individual mold cavities 1 through a number of gates (not designated). The upper mold member M2 has a sprue 4 through which a colored melted synthetic resin material is forced by a single injection cylinder 5 into the mold cavities 1. A plurality (three in the illustrated embodiment) of elongate recesses 6 are defined in the mold surface of each mold member M1, M2 and they extend parallel to the runner 3 along the corresponding lands 2 for receiving the previous injection-molded coupling elements. The elongate recesses 6 each have a length which is twice the length of the individual mold cavity groups, and hence the length of the individual rows of injection-molded coupling elements. The length of the recesses 6 is an integral multiple of the length of each group of mold cavities 1 and varies as the number of colors used is changed. The mold assembly M further includes a reciprocably movable positioning pin 7

disposed at one end of the lower mold member M1 and projectable from the mold surface of the mold member M1 to position the previous injection-molded coupling elements with respect to the mold cavities 1 before the
5 next injecting operation starts.

Operation of the injection-molding machine is as follows. While the mold assembly M is held in the fully opened position, a pair of parallel spaced stringer tapes T, T is introduced between the upper and
10 lower mold members M2, M1 so that inner longitudinal edges of the stringer tapes T, T overlap the rows of mold cavities 1. Then the mold assembly M is fully closed. With this condition, a melted synthetic resin material of a desired color is injected by the
15 injection cylinder 5 into the individual cavities 1 through the sprue 4, the runner 3 and the gates, thereby forming a plurality (three in the illustrated embodiment) of longitudinally spaced rows of injection-molded coupling elements E1 secured to the
20 inner longitudinal edge of each stringer tape T. The injection-molded coupling elements E1 are cooled for a predetermined period of time.

Upon expiration of the predetermined cooling time, the mold assembly M is fully opened, at the time
25 of which the positioning pin 7 is projected from the mold surface of the lower mold member M1 and the injection-molded coupling elements E1 are ejected out

of the mold cavities 1 by means of a plurality of ejector pins (not shown). Then the stringer tapes T are fed in a longitudinal direction until a trailing end of a runner portion 8 of the injection-molded coupling elements E1 engages the positioning pin 7, as shown in Figure 1A. The mold assembly M is closed again and the foregoing steps of molding operation are repeated until the injection-molded coupling elements E1 are formed on the stringer tapes T along the length thereof with a plurality of element-free portions 9 between successive rows of injection-molded coupling elements E1. Thereafter, a plurality of sprue portions 4a (Figure 3), the runner portions 8 and the gate portions are removed in a known manner from the injection-molded coupling elements E1.

The stringer tapes T with thus injection-molded coupling elements E1 of the desired color are introduced again into the molded assembly M while the latter is fully opened. In this instance, the individual rows of injection-molded coupling elements E1 are received in corresponding ones of the elongate recesses 6 with a leading end of each coupling element row located next to a trailing mold cavity 1 of each mold cavity group. With this condition, the mold assembly M is fully closed and a melted synthetic resin material of a desired color, which is different from the color of the previous injection-molded coupling

elements E1, is injected by the injection cylinder 5 into the mold cavities 1 through the sprue 4, the runner 3 and the gates. Thus, three longitudinally spaced rows of injection-molded coupling elements E2 are formed at once on and along the respective element-free portions 9 of each stringer tape T in an end-to-end relation to adjacent ones of the previous injection-molded coupling elements E1. After the injection-molded coupling elements E2 have been formed on all the element-free portions 9 of the respective stringer tapes T, as shown in Figure 1B, sprue portions, runner portions and the gate portions are removed from the injection-molded coupling elements E2. In this condition, each stringer tape T still has a plurality of element-free portions 9a between successive rows of injection-molded coupling elements E1, E2, each element-free portion 9a having a length which is equal to the length of each group of mold cavities 1.

20 The stringer tapes T having the injection-molded coupling elements E1, E2 of different colors are introduced into the same mold assembly M in such a manner that the coupling elements E1, E2 are received in the respective elongate recesses 6 and the element-free portions 9a are held in registry with the mold cavities 1. While the mold assembly M is fully closed, a melt synthetic resin material of a color,

which is different from the colors of the previous injection-molded coupling elements E1, E2, is injected by the cylinder 5 into the mold cavities 1. Thus, three rows of injection-molded coupling elements E3 are formed respectively between the previous injection-molded coupling elements E1 and the previous injection-molded coupling elements E2, as shown in Figure 1C. In this condition, the element-free portions 9, 9a shown in Figures 1A and 1B are no longer existence as they are fully occupied with the injection-molded coupling elements E1, E2, E3. After sprue portions, runner portions and gate portions (neither designated) have been removed, the slide fastener stringers S, S, as shown in Figure 2, are connected together by coupling the rows of injection-molded coupling elements E1, E2, E3 of three different colors by means of a slider SL.

A modified injection molding method shown in Figures 4A-4C is reduced to practice by a mold assembly M' having a pair of relatively movable mold members M" (only one shown in Figure 11). Each mold member M" has a pair of rows of mold cavities 10 extending throughout the length thereof and a runner 11 extending between the rows of mold cavities 10, the runner 10 and the individual mold cavities 10 are connected together by a number of gates (not designated). The row of mold cavities 10 have a length equal to the length of a group of coupling elements to be injection-molded.

With the use of the mold assembly M', a melt synthetic resin material of a desired color is injected into the mold cavities 10 to form a row of injection-molded coupling elements E1 on each stringer tape T along one longitudinal edge thereof. Then the stringer tapes T are moved in a longitudinal direction by a distance until a trailing end of a runner portion 12 of the molded-coupling element E1 engages a positioning member 13 (Figure 4A), the distance being twice the length of the mold cavities 10. This distance is an integral multiple of the length of the mold cavities 10 and is determined by the equation $D=L (N-1)$ where D is the distance of movement of each stringer tape T, L is the length of the mold cavities 10 and N is the number of colors to be used. The foregoing steps of molding operation are repeated until a plurality of longitudinally spaced rows of injection-molded coupling elements E1 are formed on each stringer tape along one longitudinal edge thereof.

The stringer tapes T are introduced again into the mold assembly M' such that the mold cavities 10 and one of rows of previous injection-molded coupling elements E1 are located end to end. Then a melted synthetic resin material of a different color is injected into the mold cavities 10 to form a row of injection-molded coupling elements E2 extending contiguously to the row of coupling elements E1. The

stringer tapes T are advanced by the above-mentioned distance and the next following row of injection-molded coupling elements E2 is formed as shown in Figure 4B. In the same figure, reference numeral 14 designates a positioning member engageable with the previous injection-molded coupling elements E1 for positioning the longitudinal tape edges with respect to the mold cavities 10. The just-mentioned molding operation is repeated for the formation of rows of injection-molded coupling elements E3 having a color which is different from the colors of the coupling elements E1, E2. The runner portions 12, sprue portions (not shown) and gate portions (not designated) may be removed either after formation of each row of injection-molded coupling elements E1, E2, E3, or upon formation of parti-colored rows of coupling elements E1, E2, E3 of different colors.

Figures 5 through 9 show various slide fastener stringers made in accordance with the present invention. The stringers shown in Figure 5 have two opposed rows of injection-molded coupling elements E4, E5, each coupling element row being composed of a plurality of longitudinally spaced groups of coupling elements E4 of one color and a plurality of groups of coupling elements E5 of another color disposed between adjacent groups of the coupling elements E4. All the coupling element groups have the same length.

Stringers shown in Figure 6 have a pair of parti-colored rows of injection-molded coupling elements composed of four different color groups E6-E9, all coupling element groups E6-E9 having the same length.

5 Slide fastener stringers shown in Figures 7 to 9 each have a parti-colored row of injection-molded coupling elements in which respective colored coupling element groups E10-E17 have different lengths. The length of individual coupling element groups can be
10 changed by displacing a control rod 15 (Figure 11) in an axial direction along the runner 11, thereby varying the effective length of the rows of mold cavities 10.

Parti-colored rows of injection-molded coupling elements shown in Figure 10 provides an attractive
15 zigzag or staggered color pattern which is obtainable when two stringers are connected together in a longitudinally displaced relation to one another.

In the foregoing embodiments, a single injection-molding machine with a single mold assembly
20 is used for reducing the inventive method into practice. The present invention is also applicable to a series of injection-molding machines each provided exclusively for forming injection-molded coupling elements of one color, the injection-molding machines
25 have the same mold assemblies each having one injection cylinder.

The method according to the present invention

has various advantages. Since a slide fastener stringer having a parti-colored row of injection-molded coupling elements can be manufactured by an injection molding machine having a single injection cylinder, various molding factors, such as heating temperature, injection pressure and the injection quantity can be maintained in a uniform condition with utmost ease. The injection-molding machine per se is compact and simple in structure and hence is easy to maintain.

10 Since the molding operation is repeated for each color, it is possible to form a row of coupling elements of a substantially unlimited number of colors. The length of individual groups of injection-molded coupling elements is variable without the necessity of

15 reconstruction of the mold assembly.

20

25



- 15 -

CLAIMS:-

1. A method of manufacturing a slide fastener stringer to include a stringer tape and a parti-colored row of injection molded coupling elements secured to the stringer tape along a longitudinal edge thereof, said method comprising the steps of:

(a) injection-molding a plurality of longitudinally spaced rows of coupling elements on a stringer tape along a longitudinal edge thereof, the rows of injection-molded coupling elements having a first color and being spaced from one another by a plurality of element-free portions;

(b) injection-molding a plurality of longitudinally spaced rows of coupling elements on the stringer tape along the respective element-free portions, the just injection-molded rows of coupling elements having a second color which is different from the first color of the previous injection-molded coupling elements; and

(c) repeating the above-mentioned step (b) until the element-free portions are occupied with the injection-molded coupling elements.

2. A method according to claim 1, the first-mentioned injection-molding step (a) comprising

(a-1) introducing the stringer tape between a pair of relatively movable mold members defining a



- 16 -

series of mold cavities;

(a-2) injecting a melted synthetic resin material of one color into the mold cavities while the mold members are fully closed;

5 (a-3) moving the stringer tape in a longitudinal direction while the mold members are fully opened until a trailing end of the just injection-molded row of coupling elements is spaced from a leading one of the mold cavities by a distance which is an integral
10 multiple of the length of the just injection-molded row of coupling elements; and

(a-3) repeating said injection and moving (a-1) and (a-2).

3. A method according to claim 2, the second-
15 mentioned injection-molding step (b) comprising

(b-1) introducing the stringer tape again between the mold members such that the mold cavities and one of the rows of previous injection-molded coupling elements are located end to end;

20 (b-2) injecting a colored melted synthetic resin material of another color into the mold cavities while the mold members are fully closed;

(b-3) moving the stringer tape in a longitudinal direction by said distance while the mold members are
25 fully opened; and

(b-4) repeating said injecting and moving (b-2) and (b-3).



- 17 -

4. A method according to claim 1, the element-free portions having a length which is an integral multiple of the length of each row of injection-molded coupling elements of the first color.

5 5. A method according to claim 1, the rows of injection-molded coupling elements of one color having a length which is different from the length of the rows of injection-molded coupling elements of another color.

6. A method according to claim 1, all the rows
10 of injection-molded coupling elements of different individual colors having the same length, the element-free portions having a length which is an integral multiple of the length of the rows of injection-molded coupling elements, the integral
15 multiple being determined by subtracting one from the number of colors of the injection-molded coupling elements.

7. A method according to claim 1, wherein each row of injection-molded coupling elements is of non-uniform length.

20



25