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METHOD OF AND APPARATUS FOR
MANUFACTURING MOLDED
SLIDE FASTENER COUPLING ELEMENTS

This invention relates generally to the production of slide fasteners having coupling or mating elements made of a thermoplastic material, and more particularly to a method and apparatus for supplying
5 such a plastic material to a molding machine for molding the same into a desired formation on a pair of stringer tapes.

Slide fastener coupling elements of a discrete formation are provided on a pair of stringer tapes most
10 commonly by means of injection-molding, in which instance runners, sprues and other debris of the element-forming plastic material are encountered that are to be removed from the slide fastener chain.

It has long since been desired to make use of
15 such runners and sprues for replenishment of a supply of starting plastic materials which are versatile in color.

However, difficulty has been experienced in obtaining homogeneous color distribution of the

fastener elements on the stringer tapes due to thermal decomposition, pollution or moisture absorption of the used runners and sprues.

According to a first aspect of the present invention, there is provided an apparatus for manufacturing a slide fastener chain having molded thereon rows of coupling elements made of a thermoplastic material, said apparatus comprising in combination with an injection molding machine having a mold, a cutting means disposed immediately adjacent to and downstream of said mold for cutting and removing runners and sprues from the row of molded coupling elements; a pelletizing means disposed adjacent to said cutting means for pelletizing said removed runners and sprues to a predetermined particle size; a first hopper for receiving and feeding the pelletized runners and sprues; a second hopper for receiving and feeding a fresh supply of pelletized thermoplastic materials; a mixing hopper for receiving and mixing the pelletized materials fed from said first and second hoppers for charging to said mold; a delivery means disposed between said pelletizing means and said first hopper for delivering the pelletized material from said pelletizing means to said first hopper; and a controlling means associated with said second hopper for controlling the amount of the feed therefrom to said mixing hopper so

that the combined feeds fall within a constant selected ratio, said controlling means comprising a reduced bottom outlet of said second hopper for adjusting the gravitational feed therefrom, said reduced bottom outlet having a slanted open end lying parallel to and spaced from a slanted inner wall of said mixing hopper, said second hopper being movable relatively to said mixing hopper to adjust the distance between said slanted open end of said reduced bottom outlet and said slanted inner wall of said mixing hopper.

According to a second aspect of the present invention, there is provided a method of manufacturing a slide fastener chain having molded thereon rows of coupling elements made of a thermoplastic material, by means of an apparatus according to the first aspect of the invention, said method comprising the steps of using said cutting means for cutting and removing runners and sprues from the rows of coupling elements immediately after the fastener chain has been withdrawn from a said mold; using said pelletizing means for pelletizing the runners and sprues to a predetermined particle size; using said first and second hoppers and said mixing hopper for recycling the thus pelletized material for re-use in combination with a fresh supply of thermoplastic chips; and using said controlling means for controlling a supply of the pelletized material and the fresh supply of thermoplastic chips to fall within a constant selected ratio, said constant selected ratio of the supply of the pelletized material to the fresh supply of thermoplastic chips being 40 - 60 : 60 - 40.

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

Figure 1 is a schematic side elevation utilized to show the general construction of an injection molding machine;

Figure 2 is a view analogous to Figure 1 but showing a preferred form of machine according to the invention;

Figure 3 is a plan view of a slide fastener chain that has been released from the molding machine of Figure 1; and

Figure 4 is a longitudinal cross-sectional view of a hopper part of the machine of Figure 2.

Referring first to Figure 3, there is shown a slide fastener chain 10 which comprises a pair of stringer tapes T, T' each carrying a series of discrete coupling elements E made of a thermoplastic material, the coupling elements having a choice of different colors compatible with an article to which the fastener is applied. The fastener chain 10 is shown disposed immediately after it has been injection-molded and released from the mold, so that the molded elements E are still accompanied by runners 11 and sprues 12 that will be subsequently removed in a manner hereinafter described.

As shown in Figure 1, a starting fastener chain 10 devoid of coupling elements E (Figure 3) is passed around a guide roll 13 and into a mold 14 comprising a

stationary die 15 and a movable die 16 in an injection-molding machine generally designated at 17. The machine 17 per se is of any conventional construction including a heating cylinder 18
5 operatively associated with the molding dies 15, 16. The fastener chain 10 after having injection-molded thereon series or rows of coupling elements E is withdrawn from the mold 14 via feed rolls 19, 20 and guide rolls 21, 22 and 23 and stored in a chamber 24 in
10 a manner well known in the art.

Cutting means 25 is provided immediately adjacent to and downstream of the mold 14 for cutting and removing runners 11 and sprues 12 (Figure 3) or other debris of
15 the plastic material that have been formed integrally with the coupling elements E. The runners 11 and sprues 12 thus removed are taken into a pelletizer 26 located adjacent to the cutting means 25 and designed to cut them into pellets or chips C_1 of a desired size.
20 These pellets or chips C_1 are collected in a reservoir 27 at the bottom of the pelletizer 26 and from there delivered or recycled to a first hopper 28 located above the heating cylinder 18, for which purpose there is provided a delivery means 29 comprising a fan 30 and
25 a conduit piping 31 communicating between the fan 30 and the first hopper 28.

Parallel with the first hopper 28 is provided a

second hopper 32 for receiving a supply of colored master chips C_2 and colorless slave chips C_3 , both being thermoplastic.

The first and second hoppers 28 and 32 are detachably mounted on a mixing hopper 33 and have their respective tapered bottomless ends opening into the mixing hopper 33 which in turn has its bottom open to communicate with the interior of the heating cylinder 18, the arrangement being that chips C_2 , C_3 are let fall by own gravity through hopper 33 into the cylinder 18.

It has now been found that the ratio of recycled chips C_1 to combined fresh chips C_2 , C_3 is importantly 40 - 60 : 60 - 40 in order to absolutely minimize reduction in physical properties of the resulting element chain E, which properties including mechanical strength and deviations or irregularities in the color of the resulting element chain E. To this end, in the machine shown in Figure 1, there are provided shutter means 34 and 35 for first and second hoppers 28, 32, respectively thereby maintaining a controlled rate of supply of respective chips C_1 , C_2 and C_3 . When the color of the element chain E to be manufactured is changed, the shutter means 34, 35 are fully closed and then the first and second hoppers 28, 32 are removed from the mixing hopper 33 for discharging the chips C_1 , C_2 , C_3 remaining the respective hoppers 28, 32.

5 In the embodiment shown in Figures 2 and 4, the second hopper 32 for fresh chips C_2 , C_3 has a reduced bottom outlet 32' with a slanted open end 32" which lies flush with a tapered inner peripheral wall 33' of the mixing hopper 33. The slanted end 32" of the hopper 33 is spaced a predetermined distance or clearance H apart from the peripheral wall 33' of the hopper 32 such that the inventory of fresh chips C_2 , C_3 in the hopper 33 may be maintained constant with respect to a given supply of recycled chips C_1 . There is provided a vertically movable bar 36 extending horizontally from a vertical column 37 secured to the frame 17' and being adapted to support thereon the second hopper 32. This bar 36 may be ascended to permit the hopper 32 to detach from the mixing hopper 33, or varied in position to adjust the clearance H thereby maintaining controlled inventory of fresh chips C_2 , C_3 with respect to recycled chips C_1 depending upon the rate of molding speed of the machine. With the 20 hoppers 28, 32, 33 thus constructed, the amount of the fresh chips C_2 , C_3 with respect to the amount of the recycled chips C_1 is maintained constant without using a separate metering device.

25 An important feature of the invention resides in the concept of removing and pelletizing runners and sprues of the plastic material from the fastener chain immediately upon release from the mold and subsequently

recycling pelletized chips for re-use in combination with fresh thermoplastic chips, so that such recycled chips may not undergo any substantial change in their physico-chemical properties which would otherwise

5 result in irregular or heterogeneous color distribution of the coupling elements on the finished slide fastener.

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CLAIMS:

1. An apparatus for manufacturing a slide fastener chain having molded thereon rows of coupling elements made of a thermoplastic material, said apparatus comprising in combination with an injection molding machine having a mold, a cutting means disposed immediately adjacent to and downstream of said mold for cutting and removing runners and sprues from the row of molded coupling elements; a pelletizing means disposed adjacent to said cutting means for pelletizing said removed runners and sprues to a predetermined particle size; a first hopper for receiving and feeding the pelletized runners and sprues; a second hopper for receiving and feeding a fresh supply of pelletized thermoplastic materials; a mixing hopper for receiving and mixing the pelletized materials fed from said first and second hoppers for charging to said mold; a delivery means disposed between said pelletizing means and said first hopper for delivering the pelletized material from said pelletizing means to said first hopper; and a controlling means associated with said second hopper for controlling the amount of the feed therefrom to said mixing hopper so that the combined feeds fall within a constant selected ratio, said controlling means comprising a reduced bottom outlet of said second hopper for adjusting the gravitational feed therefrom, said reduced bottom outlet having a slanted open end lying parallel to and spaced from a slanted inner wall of said



mixing hopper, said second hopper being movable relatively to said mixing hopper to adjust the distance between said slanted open end of said reduced bottom outlet and said slanted inner wall of said mixing hopper.

2. An apparatus according to claim 1, said constant selected ratio of the pelletized material to the fresh supply of thermoplastic material being 40 - 60 : 60 - 40.

3. An apparatus according to claim 1 or 2, said second hopper being detachably mounted on said mixing hopper.

4. A method of manufacturing a slide fastener chain having molded thereon rows of coupling elements made of a thermoplastic material, by means of an apparatus according to claim 1, 2 or 3, said method comprising the steps of using said cutting means for cutting and removing runners and sprues from the rows of coupling elements immediately after the fastener chain has been withdrawn from said mold; using said pelletizing means for pelletizing the runners and sprues to a predetermined particle size; using said first and second hoppers and said mixing hopper for recycling the thus pelletized material for re-use in combination with a fresh supply of thermoplastic chips; and using said controlling means for controlling a supply of the pelletized material and the fresh supply of thermoplastic chips to fall within a constant selected ratio, said constant selected ratio of the supply of the pelletized material to the fresh supply of thermoplastic chips being 40 - 60 : 60 - 40.



5. Apparatus substantially as described with reference to and as illustrated in Figures 2 and 4 of the accompanying drawings.

6. A method of manufacturing a slide fastener chain
5 by means of an apparatus substantially as described with reference to and as illustrated in Figures 2 and 4 of the accompanying drawings.
