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APPARATUS FOR MANUFACTURING

A CONTINUOUS SLIDE FASTENER STRINGER

The present invention relates to an apparatus for manufacturing a continuous slide fastener stringer including a stringer tape and a row of injection-molded coupling elements secured to the stringer tape along a longitudinal edge thereof.

One example of such apparatus as described is disclosed in the Japanese Patent Publication (Kokoku) No. 53-28309 published on August 14, 1978. The disclosed apparatus includes a pair of fixed and movable mold members having a predetermined number of cavities, and a tape feeder disposed downstream of the movable mold member for intermittently advancing successive parts of a stringer tape one at a time, one of successive parts of the tape extending through the mold members at an angle to confronting mold surfaces of the latter. The stringer tape part thus held is liable to be displaced out of alignment with the mold

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cavities as the movable mold member is moved to its fully closed position. A beaded, element-supporting edge of such misaligned tape part is partly deformed or otherwise crushed by the mold surfaces, and a row of
5 injection-molded coupling elements secured to such crushed element-supporting edge cannot perform a requisite function.

Another apparatus disclosed in Japanese Utility Model Laid-open Publication (Kokai) No. 55-10733
10 published on January 23, 1980 comprises a feeler projecting from a mold surface on a fixed mold member toward a mating mold surface on a movable mold member and engageable with the trailing end of a row of injection-molded coupling elements secured to a portion
15 of a stringer tape to position a succeeding part of the stringer tape with respect to the mold members. The disclosed apparatus, however, has no means for moving the stringer tape between a position in which the tape is spaced from the mold surface and held out of
20 interference with the feeler, and a second position in which the tape lies flatwise on the mold surface. With this arrangement, the movement of the movable mold member toward the fixed mold member must be temporarily interrupted for a period during which time the stringer
25 tape is fed in the reversed direction until the trailing end of the previous injection-molded coupling elements abuts against the feeler. The apparatus thus

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constructed is difficult to operate at a relatively high speed.

According to the present invention, there is provided an apparatus for manufacturing a continuous slide fastener stringer including a continuous stringer tape and a row of injection-molded coupling elements secured to the stringer tape along a longitudinal edge thereof, said apparatus comprising; a frame; two mold members, one fixed and the other movable, supported on said frame and defining a series of mold cavities, said movable mold member being reciprocally movable between advanced position in which said mold members are fully closed to hold one of successive parts of the stringer tape, and a retracted position in which said mold members are fully opened for the passage therethrough of the stringer tape, said mold members having two mating mold surfaces, respectively, a feeler disposed on one of said mold members adjacent to a trailing end of said mold cavities and projecting from the mold surface of said one mold member toward the mold surface of the other mold member for detecting a trailing end injection-molded coupling element; and means disposed upstream and downstream of said mold members for intermittently advancing the stringer tape through said mold members, said stringer-tape advancing means comprising a pair of drive and pinch rolls disposed downstream of said mold members, said drive

roll being drivable to rotate in opposite directions,
and a tension roll vertically movably disposed
upstream of said mold members and carried on the
stringer tape, CHARACTERIZED IN THAT said feeler is
5 disposed on said movable mold member, that a first
tape shifter and a second tape shifter are mounted
on said movable mold member respectively upstream
and downstream of said movable mold member and are
movable, in timed relation to said stringer-tape
10 advancing means, with respect to said movable mold
member to move said one part of the stringer tape
between a first position in which said one part of the
stringer tape lies flatwise on said mold surface of
said movable mold member and said trailing end
15 injection-molded coupling element is engageable with
said feeler, and a second position in which said one
part of the stringer tape is spaced away from the
last-mentioned mold surface and is held out of
interference with said feeler, in that said drive and
20 pinch rolls are rotatably mounted on said second tape
shifter, and in that said stringer-tape advancing means
further includes a braking device mounted on said first
tape shifter for applying a braking force to said stringer
tape, and a roll holder mounted on said first tape
25 shifter for preventing the downward movement of said
tension roll, said tension roll being vertically
movably supported on said first tape shifter downstream
of said braking device and carried on the stringer tape

extending between said braking device and said drive and pinch rolls.

It is believed possible by means of the present invention to provide an apparatus for manufacturing a continuous slide fastener stringer including a row of injection-molded coupling elements secured to a continuous stringer tape along a longitudinal edge at a rapid rate of production.

It is also believed possible by means of the present invention to provide an apparatus by which a stringer tape can be properly positioned on a mold surface of a movable mold member and hence is prevented from being deformed at a longitudinal edge thereof by mating mold surfaces of the mold members.

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

Figure 1 is a schematic front elevational view of an apparatus embodying the present invention;

Figure 2 is an enlarged fragmentary front elevational view, partly in cross section, of a portion of the apparatus of Figure 1;

Figure 3 is a cross-sectional view taken along line III-III of Figure 2; and

Figure 4 is an enlarged fragmentary view of a movable mold member with a pair of slide fastener stringers, showing the manner in which a pair of rows of injection-molded coupling elements are formed on a pair of stringer tapes along their respective inner longitudinal edges.

Figure 1 shows an apparatus 10 for manufacturing a pair of continuous slide fastener stringers 11, 11 (only one of which is described here for clarity) each including a stringer tape 12 and a row of injection-molded coupling elements 13 (Figures 2 and 4) secured to the stringer tape 12 along a longitudinal edge thereof.

The apparatus 10 comprises a pair of relatively movable mold halves or members 14, 15 supported on the frame 16 and defining a predetermined number of mold cavities 17 (Figure 4), and means (described below) disposed both upstream and downstream of the mold members 14, 15 for intermittently advancing successive parts of the stringer tape 12 through the mold members 14, 15. The mold member 14 is fixed on the frame 16 while the mold member 15 is slidably mounted on tie rods 18 extending horizontally between the fixed mold member 14 and an upstanding support 19 fixed on the frame 16. An actuator or fluid-actuated cylinder 20 is mounted on the support 19 and is operatively connected to the movable mold member 15. Thus, the movable mold

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15 slides on the tie rods 18 toward and away from the fixed mold member 14 upon energization and de-energization of the cylinder 20. The frame 16 also supports thereon an injector 21 having a nozzle 22 opening to a sprue (not shown) in the fixed mold member 14 for injecting melted synthetic resin material into the mold cavities 17, while the mold members 14, 15 are fully closed. A hopper 23 is mounted on the injector 21 for supplying the latter with solid synthetic resin material.

The apparatus 10 further comprises an upper tape shifter 24 and a lower tape shifter 25 respectively disposed upstream and downstream of the movable mold member 15 for moving one of the successive parts of the stringer tape 12 between a first position in which the part of the stringer tape 12 lies on a mold surface 26 of the movable mold member 15 and a trailing end of the previous injection-molded coupling elements is engageable with a feeler (described below), and a second position (Figures 1 and 2) in which the stringer tape part is spaced from the mold surface 26 by a predetermined distance (described below). Gate portions 27 and a runner portion 28 (both shown in Figure 4) of the injection-molded coupling elements 13 are removed and then fall into a hopper 29 disposed below the movable mold member 15, as the stringer tape 12 passes through the lower tape shifter 25.

As shown in Figure 2 and 3, the upper tape shifter 24 includes an actuator 30 mounted on the movable mold member 15, and a base 31 operatively connected to the actuator 30 and movable relative to the movable mold member 15 in opposite directions indicated by the arrowheads A (Figure 2) upon operation of the actuator 30. More specifically, the actuator 30 comprises a fluid-actuated cylinder including a cylinder block 32 secured to an upper end of the movable mold member 15, a piston 33 movable within a cylinder bore 34, and a piston rod 35 connected at one end to the piston 34 and at the opposite end to the base 31. The base 31 is slidably mounted on the cylinder block 32 via linear-motion bearings 36.

15 The stringer-tape advancing means includes tensioning means 37 disposed upstream of the movable mold member 15 for supporting the stringer tape 12 with a constant tension. The tensioning means 37 includes a pair of horizontally spaced guide rolls 38, 39
20 rotatable on a horizontal bracket 40 supported on upper ends of a pair of vertical guide posts 41, and a tension roll 42 rotatable on the stringer tape 12 hung on and between the guide rolls 38, 39. The tension roll 42 is rotatably mounted on a support 43 slidably
25 mounted on the guide posts 41. The tension roll 42 and the support 43 are thus movable between a raised position (Figure 2 and 3) and a lowered position,

keeping the tension of the stringer tape 12 constant. The tension roll 42 moves the stringer tape 12 in the reverse direction as it moves downwardly by its own weight. A roller 44 is mounted on the support 43 below
5 the tension roll 42.

A roll holder 45 for holding the tension roll 42 selectively in its raised or lowered position is mounted on a vertical bracket 46 supported on the base 31. The holder 45 includes a holding lever 47 fixed to
10 a horizontal shaft 48 pivotably mounted on the bracket 46, the lever 47 having a distal end 49 supporting thereon the roller 44. The shaft 48 is driven by a suitable drive means (not shown) to angularly move the lever 47 between a raised position (solid line in
15 Figure 2) and a lowered position (phantom line in Figure 2) with the roller 44 carried on the lever 47. Thus, the support 43 and hence the tension roll 42 is selectively held in its raised or lowered position.

As shown in Figure 2, a braking device 50 is
20 disposed upstream of the tensioning means 37 for applying a braking force to the stringer tape 12. The braking device 50 includes a guide roll 51 rotatable on the bracket 46 for guiding the stringer tape 12 therearound, and a brake lever 52 rockably supported at
25 one end thereof on the bracket 46 and having at the opposite end a brake shoe 53. Upon rocking movement of the braking lever 52, the brake shoe 53 and the guide

roll 51 are brought into and out of locking engagement of the stringer tape 12 extending therebetween. A tape guide 54 is mounted on the bracket 46 for guiding the stringer tape 12 to the guide roll 51. Another tape
5 guide 55 is mounted on the base 31 between the guide roll 38 and the mold members 14, 15. The tape guide 55 has a vertical guide slot 55a extending parallel to the mold surface 26 for the passage therethrough of the stringer tape 12.

10 As shown in Figure 2 and 3, the lower tape shifter 25 includes an actuator 56 mounted on the movable mold member 15, and a base 57 operatively connected to the actuator 56 and movable relative to the movable mold member 15 in opposite directions
15 indicated by the arrowheads B (Figure 2) upon operation of the actuator 56. More specifically, the actuator 56 comprises a fluid-actuated cylinder including a cylinder block 58 secured to a lower end of the movable mold member 15, a piston 59 movable within a cylinder
20 bore 60, and a piston rod 61 connected at one end to the piston 59 and at the opposite end to the base 57. The base 57 is slidably mounted on the cylinder block 58 via linear-motion bearings 62.

The stringer-tape advancing means further
25 includes a drive roll 63 fixed to a drive shaft 64 rotatably mounted on a vertical bracket 65 depending from the base 57. The drive shaft 64 is driven by a

suitable drive means (not shown) to positively rotate the drive roll 63 in opposite directions. A pair of spaced pinch rolls 66, 67 presses the stringer tape 12 against the periphery of the drive roll 63 to move the
5 stringer tape 12.

A disc cutter 68 is secured to the shaft 64 and has a cutting edge 68a projecting beyond the periphery of the drive roll 63. The cutter 68 thus severs the gate portions 27 and the runner portion 28 of the
10 injection-molded coupling elements 13 as the stringer tape 12 passes through between the rolls 63, 66. The gate and runner portions 27, 28 thus removed fall into the hopper 29.

A stringer guide 69 is disposed immediately
15 above the nipping point between the feed roll 63 and the pinch roll 66. The stringer guide 69 has a vertical guide channel 69a extending in alignment with the guide slot 55a in the tape guide 55 for the passage therethrough of the slide fastener stringer 11 so that
20 the stringer tape 12 extends parallel to the mold surface 26 between the guides 55, 69.

A feeler 70 is disposed on the movable mold member 15 adjacent to the lowermost (leading) mold cavity 17a (Figure 4), and projects from the mold
25 surface 26 toward a mating mold surface 71 on the fixed mold member 14. The fixed mold member 14 has an opening 72 for receiving the feeler 70 when the mold

members 14, 15 are fully closed. The feeler 70 engages the trailing end coupling element 73 to stop reverse feeding of the stringer tape 12 by the rolls 63, 66 as described below. This feeler 70 is positioned such
5 that the injection-molded coupling elements 13 have a uniform element pitch across two successive rows of such injection-molded coupling elements 13. The fluid-actuated cylinders 30, 56 have the same stroke which is larger than the length of a portion of the feel-
10 er 70 projecting from the mold surface 26, and are operative in synchronism with each other to extend or retract their piston rods 35, 61 at the same time.

The apparatus 10 operates as follows. For the purpose of illustration, the operation begins from the
15 condition shown in Figure 2 in which the movable mold member 15 is held in the fully opened position; the advancing movement of the stringer tape 12 is stopped with a trailing end 73 of the previous injection-molded coupling elements 13 slightly overrun of the feeler 70;
20 the tension roll 42, which has been moved upwardly under an increased tape tension during the advancing movement of the tape 12, is held in its raised position by the holding lever 49 actuated to angularly move from the lowered position (phantom line) to the raised
25 position (solid line) simultaneously with the stoppage of the tape feed; and the brake lever 52 is actuated to pivot in the clockwise direction simultaneously with

the stoppage of the tape feed to thereby lock the stringer tape 12 between the guide roll 51 and the brake shoe 53.

In response to the stoppage of the tape feed, a
5 detector (not shown) sends a signal to the actuators 30, 56 whereupon the actuators 30, 56 are energized to simultaneously retract (or move rightward) the bases 31, 57 of the upper and the lower tape shifters 24, 25 so that a length of the stringer tape 12 is forced by
10 the guides 55, 69 to lie flatwise on the molding surface 26 of the movable mold member 15. Simultaneously, the movable mold member 15 is moved toward the fixed mold member 14 by the cylinder 20 energized by a signal from the detector.

15 In response to the completion of the retracting movement of the bases 31, 57 by the actuators 30, 56, the holding lever 47 is actuated to angularly move about the shaft 48 from the raised position (solid line) to the lowered position (phantom line), thereby
20 allowing the support 43 and hence the tension roll 42 to move downwardly toward the base 31 by its own weight. Downward movement of the tension roll 42 causes the tape 12 to move in the reversed direction, during the time of which the drive roll 63 is reversely
25 driven at such a speed that the tension roll 42 can apply a tension to the tape 12 between the braking device 50 and the drive and pinch rolls 63, 66. The

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reverse feeding of the tape 12 is stopped when the trailing end 73 of the injection-molded coupling elements 13 abuts against the feeler 70. At this time, the drive roll 63 ceases rotating in the reversed or clockwise direction. Thus one of successive parts of the stringer tape 12 is properly placed flatwise on the mold surface 26 of the movable mold member 15. Slightly thereafter or ideally at substantially the same time, the movable mold member 15 is brought into the fully closed position.

With this condition, melted synthetic resin material is injected into the mold cavities 17 in the mold members 14, 15 to form a predetermined number of the coupling elements 13. The injection-molded coupling elements 13 are cooled for a predetermined period of time, during the time of which the bases 31, 57 of the tape shifters 24, 25 are moved by the actuators 30, 56 to the position of Figure 2. In order to prevent the stringer tape 12 from being unduly stretched during the forward movement of the bases 31, 57, the drive roll 63 is reversely driven by a limited angle. An increased tension on the stringer tape 12 cause the tension roll 42 to slightly move upwardly.

Upon expiration of the predetermined cooling time, the movable mold member 15 is moved from the fully closed position to the fully opened position (Figure 2), at which time the injection-molded coupling

elements 13 are ejected out of the mold cavities 17 by means of a plurality of ejector pins (not shown).

Simultaneously with the ejecting of the injection-molded coupling elements 13, the brake lever 5 52 is pivotally moved from the locking position (solid line) to the releasing position (phantom line), thereby releasing the tape 12 from the locking engagement with the guide roll 51 and the brake shoe 53. At the same time, the drive roll 63 is driven to advance the 10 stringer tape 12 for a predetermined distance until a trailing end 73 of the coupling elements 13 just molded is detected by the detector. The runner and gate portions 28, 27 (Figure 4) are removed by the cutter 68 as the stringer tape 12 passes through between the 15 drive and pinch rolls 63, 64, as shown in Figure 2. The runner and gate portions 28, 27 thus removed fall into the hopper 29. The tension roll 42 is moved upwardly under an increased tape tension during the advancing movement of the tape 12. Upon stoppage of 20 the tape's advancing movement, the holding lever 49 holds the tension roll 42 in the raised position and the braking device 50 locks the stringer tape 12. Thus, one cycle of operation for one of successive parts of the stringer tape 12 has been completed. The same 25 operation is repeated for a succeeding part of the stringer tape 12.

Thus, the stringer tape can be positioned by the

tape shifters on the mold surface of the movable mold member during the advancing movement of the movable mold member toward the fixed mold member, with the result that a cycle time of the apparatus is shortened.

- 5 As the tape shifters move in timed relation to the tape advancing means, the stringer tape is positioned accurately with respect to the mold cavities.

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Claims:-

1. An apparatus for manufacturing a continuous slide fastener stringer including a continuous stringer tape and a row of injection-molded coupling elements secured to the stringer tape along a longitudinal edge thereof, said apparatus comprising;

(a) a frame;

(b) two mold members, one fixed and the other movable, supported on said frame and defining a series of mold cavities, said movable mold member being reciprocally movable between an advanced position in which said mold members are fully closed to hold one of successive parts of the stringer tape, and a retracted position in which said mold members are fully opened for the passage therethrough of the stringer tape, said mold members having two mating mold surfaces, respectively,

(c) a feeler disposed on said movable mold member adjacent to a trailing end of said mold cavities and projecting from the mold surface of said movable mold member toward said mold surface of said fixed mold member for detecting a trailing end injection-molded coupling element;

(d) means disposed upstream and downstream of said mold members for intermittently advancing the stringer tape through said mold members;

(e) a first tape shifter and a second tape shifter mounted on said movable mold member respectively upstream and



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downstream of said movable mold member and movable, in
timed relation to said stringer-tape advancing means,
with respect to said movable mold member to move said
one part of the stringer tape between a first position
5 in which said one part of the stringer tape lies flat-
wise on said mold surface of said movable mold member
and said trailing end injection-molded coupling element
is engageable with said feeler, and a second position
in which said one part of the stringer tape is spaced
10 away from the last-mentioned mold surface and is held
out of interference with said feeler; and

(f) said stringer-tape advancing means comprising
a pair of drive and pinch rolls rotatably mounted on
said second tape shifter, said drive roll being drivable
15 to rotate in opposite directions, a braking device
mounted on said first tape shifter for applying a
braking force to said stringer tape, a tension roll
vertically movably supported on said first tape shifter
downstream of said braking device and carried on the
20 stringer tape extending between said braking device and
said drive and pinch rollers, and a roll holder mounted
on said first tape shifter for preventing the downward
movement of said tension roll.

2. An apparatus according to Claim 1, including a
25 disc cutter associated with said drive roll for
corotation therewith and having a cutting edge projecting
beyond the periphery of said drive roll.



3. An apparatus according to Claim 1 or 2, each said tape shifter including a power-driven actuator fixedly mounted on said movable mold member, a base operatively connected to said actuator and reciprocally movable perpendicularly to said mold surface of said movable mold member upon energization and de-energization of said actuator, and means mounted on said base for guiding the stringer tape to extend in a plane parallel to said mold surface of said movable mold member.

4. An apparatus according to claim 3, said actuator comprising a fluid-actuated cylinder including a cylinder block secured to said movable mold member and a piston rod, said base being mounted on said cylinder block via linear-motion bearings and connected to said piston rod.

5. An apparatus according to Claim 3 or 4, said stringer tape advancing means including at least one vertical guide post extending from said base of said first tape shifter, a support slidably mounted on said guide post, a pair of horizontally spaced guide rolls rotatably supported on said guide post above said support, said tension roll being rotatably supported on said support and being adapted to be carried on the stringer tape hung on and between said guide rolls, and a roller rotatably mounted to said support, said roll holder comprising a rockingly movable holding lever pivoted at one end to the last-mentioned base and



having the opposite end held in engagement with said roller

5 6. An apparatus according to Claim 1, 2, 3, 4 or 5
said braking device including another guide roll
rotatably mounted to said base of said first tape shifter and
guiding the stringer tape therearound, and a brake
lever rockingly movable toward and away from said
another guideroll and having a brake shoe engageable
10 with the tape extending around said another guide roll
to lock the same between said another guide roll and
said brake shoe.

