

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO INJECTION MOULDING MACHINES

(71) We, THE BRITISH BATA SHOE COMPANY LIMITED, a British Company, of East Tilbury, Grays, Essex, RM18 8RL, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to an injection moulding method and machine, and in particular to a method and machine for the injection moulding of shoe soles.

In general, injection moulding machines of the type at present being used by the applicant for forming and bonding shoe soles to uppers include a turntable rotatably mounted on a fixed base and supporting a plurality of moulds. Each mould includes mould sides and a piston-operated base. A plurality of supports for lasted uppers, equal in number to the number of moulds, is mounted on a column extending upwardly from the centre of the turntable for rotation therewith.

In order to produce a shoe, a lasted upper, i.e. a last with a shoe upper mounted thereon, is moved downwardly at a moulding station to close a mould cavity formed by the mould sides and mould piston, and a sole is moulded successively onto the base of each lasted upper at the moulding station. Immediately prior to moulding, the lasted upper closes the top of the mould, i.e., the mould cavity is formed and the turntable is rotated so that the mould opposes the dispensing head of a horizontal injector, which injects a charge of thermoplastic material, e.g. polyvinyl chloride, into the mould under pressure. Usually, two injectors are used, with one injector on each side of the turntable for injecting two different coloured thermoplastic materials into the mould. After injection the turntable is rotated to an unloading station where the mould is opened and the completed shoe, now on a top last, is removed. Thus, a two-colour shoe sole can be quickly produced in a relatively simple machine.

Various features of the above-described

machine have been previously disclosed. For example, our patent Specification 1370667 discloses an injection cut-off switch device for use in the above injection moulding machine. The switch device ensures that the same predetermined quantity of thermoplastic material is injected into each mould of a given size during each injecting operation. The switch device includes a microswitch resiliently mounted on the base of each mould, and an actuator rod coupled to the mould piston and having a free lower end for actuating the microswitch to stop injection of thermoplastic material into the mould, means for adjusting the length of the actuator rod, and cam means associated with the actuator rod and the microswitch for maintaining the distance between the actuator rod and the microswitch constant during a moulding operation. Such a switch device can also be used in the machine in the present invention.

While such machines are effective in producing shoe soles relatively rapidly, there is always a need for quicker and more efficient production techniques. The object of the present invention is to provide a method and machine for the injection moulding of shoe soles which speed up the production time for such soles, and result in a two-colour or two-material product.

Accordingly, the present invention provides an injection moulding machine for producing shoe soles comprising a fixed base; a turntable for rotation relative to said base between a plurality of stations; a plurality of moulds each including a mould piston and mould sides mounted on said turntable, the number of moulds being equal to the number of stations; a column extending upwardly from and being rotatable with said turntable; a plurality of last holders mounted on said column, and number of last holders being equal to the number of moulds; a dummy last mounted on one side of each of said last holders for closing said mould to define a first mould cavity with said mould sides and piston for moulding of a first sole portion at a first moulding

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station; and a last on each of two opposing surfaces of said last holder adjacent said dummy last for receiving uppers and closing a mould cavity defined by said mould sides, mould piston and first sole portion to mould a second sole portion between said first sole portion and the lasted upper at another moulding station opposite said first moulding station.

The invention will now be described in greater detail with reference to the accompanying drawings, wherein:

Figure 1 is an elevation view of an injection moulding machine in accordance with a preferred form of the present invention;

Figure 2 is a schematic plan view of the machine of Figure 1;

Figures 3 and 4 are front and elevation views, respectively of a last holder used for the two colour moulding method defined herein;

Figure 5 is a bottom view of a dummy last used for the machine;

Figure 6 is a cross-sectional view taken generally along line 6—6 of Figure 5;

Figures 7 and 8 are schematic longitudinal sectional views of the moulds used in the machine of Figure 1;

Figure 9 is an enlarged, schematic longitudinal sectional view of a portion of a shoe sole moulded in the machine of Figure 1;

Figures 10 and 11 are schematic cross-sectional views of a mould and mould operating assembly used in the machine of Figure 1;

Figures 12 and 13 are schematic longitudinal sectional views of a mould and associated elements used in the two moulding operations involving the machine of Figure 1;

Figure 14 is a cross-sectional view of a dummy last for use in the apparatus of Figure 1;

Figure 14A is an enlarged cross-sectional view of a portion of the dummy last of Figure 14 in moulding position above a mould piston;

Figure 15 is a bottom view of a shoe sole formed using the dummy last of Figure 14; and

Figure 16 is a cross-sectional view taken along the line 16—16 of Figure 15.

With reference to the drawings, and in particular to Figures 1 and 2, the injection moulding machine of the present invention includes a base 1 which rests on a floor and rotatably supports a turntable 2. The turntable 2 is generally circular and is provided with six moulds 3 for receiving liquid plastic material from a pair of injectors 4. Powdered or granular thermoplastic material is fed into a hopper 5 at one end of each of the injectors 4 and emerges in liquid form through a dispensing head 6 into one end of a mould 3.

A central column 8 on the turntable 2 is provided with six last holders 10 located above the turntable 2 at 60° to each other. Each last holder 10 supports two lasts 11 (not shown

in Figure 1), one on each of two opposing surfaces 12, a dummy last 13 on a surface 14 between the surfaces 12, and a counterbalance 15 on the other surface 14' between the surfaces 12 of the last holder 10. The last holders 10 are rotatably and vertically slidable on the column 8, so that a first mould cavity can be formed using the dummy last 13 to produce a first sole portion. The dummy last is then raised to open the first mould, which is moved with the turntable to a second moulding position. Before reaching the second moulding position, the last holder is rotated so that a lasted upper extends downwardly. The lasted upper is moved downwardly to close the mould at a second moulding station, a second sole portion is moulded using the second injector, and the lasted upper with the finished sole is moved upwardly to open the mould. Finally, the finished shoe is rotated to an unloading position which corresponds to the loading position for uppers. The use of two lasts for receiving uppers provides a long solidification time for the thermoplastic material forming the shoe soles, but permits continuous, efficient operation of the moulding machine. Referring to Figures 3 and 4, wherein one form of last holder 10 is shown, it will be noted that the last holder includes four faces or surfaces. As mentioned above, two lasts 11 are supported on the opposing surfaces 12, and the dummy last 13 is supported on a surface 14 between the surfaces 12. The dummy last is in the form of a plate 16 having the shape of a shoe sole. The plate 16 (Figures 3 to 6) is mounted on one end of a rod 17, which is connected to the last holder 10 by a second rod (not shown) in a sleeve 19, and knurled nut 20 permitting adjustment of the position of the plate 16 relative to the last support 10.

The structure of the dummy last 13 proposed herein is important. When moulding a first sole portion, the mould cavity is formed by mould sides, a mould piston and the dummy last. Upon completion of the first moulding operation, the mould sides are opened and the dummy last is raised for replacement by a lasted upper. In general, the first sole portion adheres as tightly to the dummy last as to the mould piston, and may travel with the dummy last 13 during upward movement thereof, rather than remaining on the mould piston for the next moulding step. In order to avoid such problem, spring loaded pins 22 are provided in the base of the dummy last 13. The particular arrangement of the pins 22 is not critical, but there should be sufficient pins to ensure complete separation of the first sole portion from the dummy last 13. As illustrated in Figures 5 and 6, the pins 22 project downwardly from the bottom surface 23 of the plate 16. Each of the pins 22 is slidably mounted in a stepped hole 25 through the body of the plate 16. A screw 27 in the top of the hole 25 holds the

pin 22 in the plate. The screw 27 is provided with a post 29 for guiding a spring 31, which biases the pin 22 outwardly from the bottom surface. During a first moulding operation, the pressure of the material being injected into the mould forces the pin 22 into the body of the plate 16. However the spring 31 biases the pin 22 outwardly, and ensures that during raising of the dummy last 13 there is a greater force acting against the dummy last side of the first sole portion. Thus, the first sole portion will remain on the mould piston.

Referring now to Figures 7 and 8, the basic moulding method of the present invention utilizes a mould cavity 35 formed by side moulds 37, a vertically movable mould piston 38 and a top mould formed by the dummy last 13 or a last 11 with an upper thereon. The first moulding step is to form the mould cavity 35 by closing the mould with the dummy last, the bottom surface of which has a configuration similar to that of a shoe insole. Thus a first sole portion 40 is formed. The first sole portion 40 may also be referred to as an insert for the second mould portion. Usually, the two sole portions have different colours or are formed of different materials.

In order to ensure that the second colour moulding material does not pass between the bottom of the first sole portion and the mould piston 38 during moulding of the second sole portion, the peripheral edge 42 of the bottom surface of the plate 16 is chamfered (Figure 6), so that the top surface of the resulting first sole portion is bevelled. Thus, if during moulding of the second sole portion the second moulding material presses against the side edges of the first sole portion, the likelihood of the edges of the first sole portion lifting is reduced by the bevelled edges.

In order to mould the second sole portion, which forms an inner sole and foxing strip around the first sole portion or insert 40, a second mould cavity is produced by replacing the dummy last 13 with a lasted upper 45. The lasted upper 45 in conjunction with the side moulds 37 and the mould piston 38 (with the first sole portion 40 thereon) forms the second mould cavity. Thus, the outer sole portion 40 is moulded first, and then the inner sole portion 44 is moulded between the lasted upper 45 and the outer sole portion 40. The product produced by this method is shown schematically in Figures 8 and 9, with the first sole portion 40 having a crenelated bottom surface. It will be appreciated that the configuration of the bottom surface of the first sole portion can take any suitable form. Since Figures 7 to 13 are merely schematic illustrations, the precise shape of the dummy plate 16 shown in Figures 5 and 6 is not illustrated.

Suitable moulds for performing the above method are shown in Figures 10 to 13.

A first mould for producing the first sole

portion 40 is formed at a first mould station 50 (Figure 2) to form the outer sole portion 40 in a mould cavity defined by the mould piston 38, the side moulds 37 and the dummy last 13. The mould piston 38 is connected to a mould cylinder 52 by a piston rod 53, so that the mould piston 38 can be moved vertically from a first moulding position to a second moulding position, where the second colour thermoplastic material, i.e., the inner sole portion 44, is moulded onto a lasted upper (Figure 11). After moulding of the outer sole portion 40, the side moulds 37 are opened, the dummy last 13 is moved upwardly while the outer sole portion 40 remains on the mould piston 38 and a lasted upper 45 is moved into position between the side moulds 37 to form a second mould cavity for moulding the inner sole portion 44. For this purpose, the mould piston 38 is moved upwardly to its second moulding position (Figure 11).

Referring now to Figures 14 to 16, a variety of shoe soles can be produced using the machine of the present invention. For example, a two-colour shoe sole can be produced, with one colour forming an outer sole or insert, and a second colour forming an inner sole with a foxing strip extending around the outer sole and plugs extending downwardly through the outer sole at various locations.

A dummy last 66 suitable for producing such a sole is illustrated in Figures 14 and 14A. It will be noted that pins 68 project outwardly from a bottom surface 69 of the dummy last 66. The pins 68 are biased outwardly by springs 71 retained in stepped holes 73 in the dummy last by screws 75. During moulding of an outer sole portion 40, the pins 68 remain in an outer position with their outer ends in small circular recesses 70 in the mould piston 38. The use of recesses 70 prevents the flow of outer sole material beneath the pins 68. Thus, the first or outer sole portion 40 has holes extending therethrough. During moulding of the second sole portion 44, moulding material fills the holes to form plugs 77 of one colour extending through the outer sole 40 of a different colour. Such plugs are merely decorative and could be arranged in any desired pattern. However, the use of a foxing strip and plugs in one colour with an insert or outer sole portion of a second colour is quite effective.

The overall operation of the machine of the present invention is best described with reference to Figure 2. Accordingly, referring to Figure 2, where the six stations involved with the machine are shown, a first operator located at station 80 initially loads the lasts 11 with uppers 45, and rotates the last holder 10 so that the dummy last 13 extends downwardly towards the moulds 3. During initial rotation of the turntable, all of the lasts 11 are loaded with uppers 45, so that subsequent operation can be continuous. With all of the lasts loaded,

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an insert or outer sole portion 40 is moulded at the first moulding position 50 in a first moulding operation.

During continuous operation, i.e., with all of the lasts 11 loaded, assuming a first mould portion or insert has been moulded at station 50, the lasts 11 are in the horizontal position one carrying a completed shoe and the other a lasted upper 45. The mould at station 50 moves through station 82 to station 80. Prior to reaching station 80, the side moulds open and the last holder moves upwardly. The first operator located at station 80 rotates the last holder so that the lasted upper 45 is above the mould, the completed shoe is removed and a new upper 45 placed onto the last 11. The turntable is then rotated to the moulding station 84. During movement of the turntable to moulding station 84, the mould is closed, i.e., the mould sides 37, the mould piston 38 and the lasted upper 45 are brought to the position shown in Figure 11, for injection of the second or inner sole portion at the second mould station 84. Upon completion of this moulding operation, the turntable is again rotated through position or station 86 while the thermoplastic material in the mould cools. Upon reaching station 88, the mould opens, a second operator turns the last holder 10 so that the dummy last 16 extends downwardly towards the mould 3. The turntable is then rotated to the moulding position 50 where the insert or outer sole portion 40 is moulded in a first moulding operation. The above cycle of operation is then repeated any number of times.

It will be appreciated that the use of two lasted uppers (Figure 2) permits the continuous operation of the machine in a relatively efficient manner. Moreover, the soles produced with the machine of the present invention may be formed of any mouldable plastics of different colours, with or without a foxing strip. In the absence of a foxing strip on the second sole portion, both layers of the sole would be visible from the sides or ends of the sole.

When moulding different soles, i.e., soles of another size or shape, the moulds are replaced on the turntable 8 and, if necessary, the length of the dummy last 13 is adjusted using the knurled nut 20.

WHAT WE CLAIM IS:—

1. An injection moulding machine for producing shoe soles comprising a fixed base; a turntable for rotation relative to said base between a plurality of stations; a plurality of

moulds each including a mould piston and mould sides mounted on said turntable, the number of moulds being equal to the number of stations; a column extending upwardly from and being rotatable with said turntable; a plurality of last holders mounted on said column, the number of last holders being equal to the number of moulds; a dummy last mounted on one side of each of said last holders for closing said mould to define a first mould cavity with said mould sides and piston for moulding of a first sole portion at a first moulding station; and a last on each of two opposing faces of said last holder adjacent said dummy last for receiving uppers and closing a mould cavity defined by said mould sides, mould piston and first sole portion to mould a second sole portion between said first sole portion and the lasted upper at another moulding station opposite said first moulding station.

2. A moulding machine according to claim 1, wherein said dummy last includes a plate in the shape of a shoe sole; rod means connecting said plate to the last holder; and first pin means slidably and resiliently mounted in said plate for facilitating removal of said first sole portion from the dummy last following moulding of the first sole portion.

3. A moulding machine according to claim 2, wherein the plate includes a moulding surface and a chamfered periphery to said moulding surface, whereby said first sole portion is formed with a bevelled peripheral edge.

4. A moulding machine according to claim 2, wherein said rod means includes first and second rods interconnected by a nut for adjusting the position of said plate relative to said last holder.

5. A moulding machine according to claim 2, wherein said dummy last includes second pin means resiliently mounted in said plate and extending outwardly therefrom, whereby, during moulding of a two-layer sole, one layer moulded on said dummy last is formed with holes extending therethrough, such holes being filled during moulding of the second layer by second layer material.

6. A moulding machine according to claim 5, wherein said mould piston includes recesses for receiving said second pin means to prevent passage of mouldable material between said mould piston and said second pin means during moulding of said one layer.

7. An injection moulding machine substantially as hereinbefore described with reference to the accompanying drawings.

an insert or outer sole portion 40 is moulded at the first moulding position 50 in a first moulding operation.

During continuous operation, i.e., with all of the lasts 11 loaded, assuming a first mould portion or insert has been moulded at station 50, the lasts 11 are in the horizontal position one carrying a completed shoe and the other a lasted upper 45. The mould at station 50 moves through station 82 to station 80. Prior to reaching station 80, the side moulds open and the last holder moves upwardly. The first operator located at station 80 rotates the last holder so that the lasted upper 45 is above the mould, the completed shoe is removed and a new upper 45 placed onto the last 11. The turntable is then rotated to the moulding station 84. During movement of the turntable to moulding station 84, the mould is closed, i.e., the mould sides 37, the mould piston 38 and the lasted upper 45 are brought to the position shown in Figure 11, for injection of the second or inner sole portion at the second mould station 84. Upon completion of this moulding operation, the turntable is again rotated through position or station 86 while the thermoplastic material in the mould cools. Upon reaching station 88, the mould opens, a second operator turns the last holder 10 so that the dummy last 16 extends downwardly towards the mould 3. The turntable is then rotated to the moulding position 50 where the insert or outer sole portion 40 is moulded in a first moulding operation. The above cycle of operation is then repeated any number of times.

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moulds each including a mould piston and mould sides mounted on said turntable, the number of moulds being equal to the number of stations; a column extending upwardly from and being rotatable with said turntable; a plurality of last holders mounted on said column, the number of last holders being equal to the number of moulds; a dummy last mounted on one side of each of said last holders for closing said mould to define a first mould cavity with said mould sides and piston for moulding of a first sole portion at a first moulding station; and a last on each of two opposing faces of said last holder adjacent said dummy last for receiving uppers and closing a mould cavity defined by said mould sides, mould piston and first sole portion to mould a second sole portion between said first sole portion and the lasted upper at another moulding station opposite said first moulding station.

2. A moulding machine according to claim 1, wherein said dummy last includes a plate in the shape of a shoe sole; rod means connecting said plate to the last holder; and first pin means slidably and resiliently mounted in said plate for facilitating removal of said first sole portion from the dummy last following moulding of the first sole portion.

3. A moulding machine according to claim 2, wherein the plate includes a moulding surface and a chamfered periphery to said moulding surface, whereby said first sole portion is formed with a bevelled peripheral edge.

4. A moulding machine according to claim 2, wherein said rod means includes first and second rods interconnected by a nut for adjusting the position of said plate relative to said last holder.

5. A moulding machine according to claim 2, wherein said dummy last includes second pin means resiliently mounted in said plate and extending outwardly therefrom, whereby, during moulding of a two-layer sole, one layer moulded on said dummy last is formed with holes extending therethrough, such holes being filled during moulding of the second layer by second layer material.

6. A moulding machine according to claim 5, wherein said mould piston includes recesses for receiving said second pin means to prevent passage of mouldable material between said mould piston and said second pin means during moulding of said one layer.

7. An injection moulding machine substantially as hereinbefore described with reference to the accompanying drawings.



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