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(54) IMPROVEMENTS IN OR RELATING TO PLASTICISING APPARATUS

(71) I, DAVID STERN, a British Subject, of 13, Rectory Close, Windsor, Berkshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to plasticising apparatus and to a method of providing a flow of plasticised plastics material.

The invention provides an apparatus for producing a flow of plasticised plastics material comprising at least two chambers connected in parallel to a common outlet, independent plasticising means associated with each chamber to plasticise material in that chamber, means to force plasticised material from each of the chambers to the outlet, and an isolator valve operable at will having a plurality of positions including a position wherein all the chambers are isolated from the outlet and positions in each of which only a selected one of the chambers is connected to the outlet.

In one form of the invention the isolator valve is such that only one chamber may be in communication with the outlet at one time.

In an alternate form of the invention the apparatus has two chambers and the isolator valve has a position wherein both of the chambers are in communication with the outlet at the same time.

The invention includes apparatus as described above in combination with an injection moulding machine in which the outlet of the apparatus is arranged to feed a mould or moulds in the injection moulding machine.

The invention also includes apparatus as de-

scribed above in combination with a blow moulding machine, in which the outlet of the apparatus is arranged to feed a mould or moulds in the blow moulding machine.

The invention also includes apparatus as described above in combination with an extrusion die, and arranged to operate as an extrusion machine.

The invention also provides a method of providing a flow of plasticised plastics material which comprises the steps of independently plasticising material in at least two separate chambers, connecting the chambers to a common outlet and forcing the plasticised material through an isolator valve to the outlet from one of the chambers while refilling another or the other chamber with material and plasticising the material in that chamber.

Preferably the plastics material is forced into a mould after leaving the outlet, and the mould is filled completely by material from only one chamber.

In this form a second mould may be completely filled by material from a second chamber while said one chamber is being refilled with, and is plasticising, further material.

In an alternative form of the invention the plastics material is forced into a mould after leaving the outlet, and the contents (or part of the contents) of more than one chamber are used to fill the mould.

In this last mentioned form it is preferred that a first chamber is connected to fill part of the mould, and is then disconnected from the mould, and then a second chamber is connected to fill another part of the mould.

Alternatively a first chamber is connected to fill a part of the mould, and a second cham-

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ber is connected to the mould to fill another part of the mould before the first chamber is disconnected from the mould.

The first chamber may be used more than once to fill the mould.

In another embodiment the chambers may be connected to the outlet serially, i.e. without interruption of the flow.

Several specific embodiments of the invention will now be described by way of example with reference to the accompanying drawings of which:—

Figure 1 is a diagrammatic view in side elevation of a typical injection moulding machine;

Figure 2 is a plan of an injection moulding machine similar to that shown in Figure 1;

Figure 3 is a partly cut away perspective view illustrating a feature of the invention;

Figure 4 is a diagrammatic view of a valve used in a first embodiment of the invention and showing three operating positions;

Figure 5 is a diagrammatic view of a rotary valve for intermittent or continuous use;

Figure 6 is a representation of the valve of Figure 5 arranged to operate a microswitch;

Figures 1, 2, 3 and 4 illustrate a first embodiment of the invention as applied to an injection moulding machine.

As shown in Figure 1 a typical injection moulding machine has a locking head 11, a moving platen 12, a fixed platen 13, and a mould 14 formed of two parts, one being mounted on each of the two platens for engagement when the platen 12 is moved adjacent the platen 13. The machine has an injection unit 15, and rotary and linear motors, generally indicated as 16, arranged to operate the injection unit 15.

Following the invention an injection unit as illustrated in Figure 3 has an outlet or nozzle 17 which is fed from two plasticisers, indicated as A and B, which plasticisers are arranged in parallel. The plasticisers have heater bands 19 which surround stationary casings 20 and within each of the casings 20 there is a screw plunger element 21 arranged to rotate within the casing, and also to move axially with respect to the casing when operated by the motors 16.

Both plasticisers are fed from a hopper 22 which is disposed above the plasticisers at their end away from the nozzle. Each plasticiser is arranged to feed the nozzle through a rotary valve 18, which is operated by a rotary actuator 23. The rotary valve is shown in diagrammatic form in Figure 4. The valve has a cylindrical housing 31 which has three passageways disposed in a plane perpendicular to the axis of the housing, two passageways 32 and 33 being spaced apart by 90° from the third passageway 34. The passageways 32 and 33 lead to chambers at the ends of the plasticisers A and B nearer to the nozzle, and the third passageway 34 leads directly to the nozzle. Within the

housing there is a rotatable feed element 35 which has an elbow conduit 36 extending between two points on its surface spaced apart by 90° in a plane perpendicular to the housing axis. The conduit 36 may be arranged to connect the passageway 34 with either of the passageways 32 and 33, or may be disposed in an intermediate position in which neither of the passageways 32 and 33 are connected to the conduit 36. The three positions of the feed element are illustrated in the variants I, II and III of Figure 4.

In use the screw plunger element 21 in the plasticiser B is initially in a "forward" position and is made to revolve. Material in the hopper 22 discharges on to the rear portion of the screw plunger element. The screw and cylinder walls are so proportioned as to transfer the material from the rear along the screw plunger element and into the chamber immediately in front of the screw. The screw is arranged to be pushed back by the increasing amount of material being delivered to the chamber in front of the screw. The rate at which this transfer from back to front takes place is determined by the efficiency and length of the heaters, the screw configuration, the power and speed available to revolve the screw and nature of the raw material, which, during its transfer from the back to the front of the screw, is converted from a form convenient as a raw material to the condition suitable for injection moulding.

When the screw has reached a backward position it is then driven forward, forcing the material through the passageway 33, the elbow conduit 36 and the nozzle 17 into the closed mould parts 14 filling all the available space in the mould with the plasticised material.

The screw continues to press forward upon the material until the part being moulded has become rigid at a gate portion of the mould. The rotary valve 18 is switched to the position II so isolating the mould for the withdrawal of the moulded article.

The screw plunger element 21 now recommences as above.

While the plasticiser B is being fed from the hopper, the plasticiser A is connected to the nozzle 17 through the rotary valve 18 via passageway 32 and the elbow conduit 36. Thus the two plasticisers alternatively rotate and move away from the nozzle to plasticise the material from the hopper; and move forward to force material into the mould. While plastics material from one plasticiser is injected into the mould, is allowed to harden, and is discharged from the mould, the other plasticiser is operating to convert raw material from the hopper into a form suitable for injection.

Depending upon choice of moulding material, moulding thickness, mould design and moulding weight in relation to capacity of the machine, the moulded part may be dis-

charged from the mould before the screw has plasticised and transferred sufficient material from the hopper to the front compartment to allow another moulding to be produced. Under these circumstances the moulding of a further part must be delayed until sufficient amount of raw material has been processed by another screw 21.

The production rate of the machine is then determined by the rate a given plasticising unit can process material during the time the

screw is not occupied in its other functions.

A typical sequence of two consecutive cycles using the device is now described by way of example:—

A 7 oz. moulding made of polypropylene is produced on units having a plasticising rate in this material of $\frac{1}{2}$ oz. per second, and requiring 3 seconds for the injection phase, and the sequence discharging the moulding from the machine taking place as indicated hereunder:—

Inject (A)	3 secs.
Hold	10 secs.
Discharge	3 secs.
Inject (B)	3 secs.
Hold	10 secs.
Discharge	3 secs.
32 secs.	

Plasticise 14 secs.

Unit B

Plasticise 14 secs.

Unit A

For 2 parts

It will be appreciated that the embodiment described above may be applied to a blow moulding machine as well as an injection moulding machine.

A further embodiment of a rotary valve is shown in Figure 5. In this case the passages from the plasticiser A and B lie at 90° to each other, and at 135° to the passage to the nozzle. Position I shows plasticiser B feeding the nozzle, Position II shows the nozzle blanked off, and Position III shows plasticiser A feeding the nozzle.

It will be appreciated that if the part 35A is turned through 180° with respect to its position II, both the passages 50 and 51 will communicate with the passages 32A and 33A, so to feed the nozzle from both plasticisers simultaneously. This enables the rotary valve of Figure 5 to be used in an extrusion operation.

Figure 6 illustrates the valve of Figure 5 (in position I) and shows a microswitch 52 operated by the valve between position I and position III to initiate another machine cycle element.

WHAT I CLAIM IS:—

1. Apparatus for producing a flow of plasticised plastics material comprising at least two chambers connected in parallel to a common outlet, independent plasticising means associated with each chamber to plasticise material in that chamber, means to force plasticised material from each of the chambers to the outlet, and an isolator valve operable at will having a plurality of positions including a position wherein all the chambers

are isolated from the outlet and positions in each of which only a selected one of the chambers is connected to the outlet.

2. Apparatus as claimed in claim 1 in which the isolator valve is such that only one chamber may be in communication with the outlet at any one time.

3. Apparatus as claimed in claim 1 in which the apparatus has two chambers and the isolator valve has a position wherein both of the chambers are in communication with the outlet at the same time.

4. Apparatus as claimed in any of the preceding claims in combination with an injection moulding machine in which the outlet of the apparatus is arranged to feed a mould or moulds in the injection moulding machine.

5. Apparatus as claimed in any one of claims 1 to 3 in combination with a blow moulding machine, in which the outlet of the apparatus is arranged to feed a mould or moulds in the blow moulding machine.

6. Apparatus as claimed in any of claims 1 to 3 in combination with an extrusion die and arranged to operate as an extrusion machine.

7. A method of providing a flow of plasticised plastics material which comprises the steps of independently plasticising material in at least two separate chambers, connecting the chambers to a common outlet and forcing the plasticised material through an isolator valve to the outlet from one of the chambers while refilling another or the other chamber with material and plasticising the material in that chamber.

8. A method as claimed in claim 7 in which



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charged from the mould before the screw has plasticised and transferred sufficient material from the hopper to the front compartment to allow another moulding to be produced. Under these circumstances the moulding of a further part must be delayed until sufficient amount of raw material has been processed by another screw 21.

The production rate of the machine is then determined by the rate a given plasticising unit can process material during the time the

screw is not occupied in its other functions.

A typical sequence of two consecutive cycles using the device is now described by way of example:—

A 7 oz. moulding made of polypropylene is produced on units having a plasticising rate in this material of $\frac{1}{2}$ oz. per second, and requiring 3 seconds for the injection phase, and the sequence discharging the moulding from the machine taking place as indicated hereunder:—

Inject (A) 3 secs.

Hold 10 secs.

Discharge 3 secs.

Inject (B) 3 secs.

Hold 10 secs.

Discharge 3 secs.

32 secs.

Plasticise 14 secs.

Unit B

Plasticise 14 secs.

Unit A

For 2 parts

It will be appreciated that the embodiment described above may be applied to a blow moulding machine as well as an injection moulding machine.

A further embodiment of a rotary valve is shown in Figure 5. In this case the passages from the plasticiser A and B lie at 90° to each other, and at 135° to the passage to the nozzle. Position I shows plasticiser B feeding the nozzle, Position II shows the nozzle blanked off, and Position III shows plasticiser A feeding the nozzle.

It will be appreciated that if the part 35A is turned through 180° with respect to its position II, both the passages 50 and 51 will communicate with the passages 32A and 33A, so to feed the nozzle from both plasticisers simultaneously. This enables the rotary valve of Figure 5 to be used in an extrusion operation.

Figure 6 illustrates the valve of Figure 5 (in position I) and shows a microswitch 52 operated by the valve between position I and position III to initiate another machine cycle element.

WHAT I CLAIM IS:—

1. Apparatus for producing a flow of plasticised plastics material comprising at least two chambers connected in parallel to a common outlet, independent plasticising means associated with each chamber to plasticise material in that chamber, means to force plasticised material from each of the chambers to the outlet, and an isolator valve operable at will having a plurality of positions including a position wherein all the chambers

are isolated from the outlet and positions in each of which only a selected one of the chambers is connected to the outlet.

2. Apparatus as claimed in claim 1 in which the isolator valve is such that only one chamber may be in communication with the outlet at any one time.

3. Apparatus as claimed in claim 1 in which the apparatus has two chambers and the isolator valve has a position wherein both of the chambers are in communication with the outlet at the same time.

4. Apparatus as claimed in any of the preceding claims in combination with an injection moulding machine in which the outlet of the apparatus is arranged to feed a mould or moulds in the injection moulding machine.

5. Apparatus as claimed in any one of claims 1 to 3 in combination with a blow moulding machine, in which the outlet of the apparatus is arranged to feed a mould or moulds in the blow moulding machine.

6. Apparatus as claimed in any of claims 1 to 3 in combination with an extrusion die and arranged to operate as an extrusion machine.

7. A method of providing a flow of plasticised plastics material which comprises the steps of independently plasticising material in at least two separate chambers, connecting the chambers to a common outlet and forcing the plasticised material through an isolator valve to the outlet from one of the chambers while refilling another or the other chamber with material and plasticising the material in that chamber.

8. A method as claimed in claim 7 in which

the plastics material is forced into a mould after leaving the outlet, and in which the mould is filled completely by material from only one chamber.

5 9. A method as claimed in claim 8 in which a second mould is completely filled by material from a second chamber while said one chamber is being refilled with, and is plasticising, further material.

10 10. A method as claimed in claim 7 in which the plastics material is forced into a mould after leaving the outlet, and in which the contents (or part of the contents) of more than one chamber are used to fill the mould.

15 11. A method as claimed in claim 10 in which a first chamber is connected to fill part of the mould, and is then disconnected from the mould, and then a second chamber is connected to fill another part of the mould.

20 12. A method as claimed in claim 10 in which a first chamber is connected to fill a

part of the mould, and a second chamber is connected to the mould to fill another part of the mould before the first chamber is disconnected from the mould.

25 13. A method as claimed in claim 11 or claim 12 in which the first chamber is used more than once to fill the mould.

14. A method as claimed in claim 7 in which the chambers are connected to the outlet serially, i.e. without interruption of the flow.

30 15. Apparatus substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

35 16. A method substantially as hereinbefore described with reference to the accompanying drawings.

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