

PATENT SPECIFICATION

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(54) NEEDLE VALVE FOR INJECTION MOULDING MACHINES.

I, EDUARD FREDDY FLYGENRING, a Danish subject, of Snebaervejl, Kr. Sonnerup 4060 Kr. Saby, Denmark, 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 present invention relates to a needle valve for an injection moulding machine.

It is common practice in the injection moulding of thermoplastics or like material to provide the discharge orifice to the dies with a needle-valve to avoid formation of a sprue on the article to be produced. The needle-valves are spring loaded so as to close the discharge orifice at the end of an injection and upon starting the next injection the needle will automatically be retracted from the discharge orifice by the pressure of the molten material acting against the spring.

Dies have large cavity volumes, e.g. for producing articles for producing a large number of small articles will be provided with a plurality of discharge orifices and the molten material which is delivered under high pressure from the injection mould machine to the orifices through a hot runner panel which is a solid element with distribution channels and heating elements to enable the desired temperature to be maintained.

For adjusting or removing the needle-valves it has generally been necessary to disassemble the dies and the hot runner panel and it has also been difficult to obtain adequate sealing against the pressure under which the molten material is introduced in the dies, so that molten material often seeps out and solidifies on the outer surface of the dies which may necessitate frequent cleaning which is inconvenient. Further the tip of the needle is usually arranged to co-operate with a frusto-conical seat in the discharge orifice when in the closed position, so that when

molten material solidifies on this seat it is not possible to achieve proper closing of the needle.

According to the present invention there is provided a needle-valve for use in an injection moulding machine's discharge orifices to a dies, which valve is arranged to be closed by spring means and opened by the pressure of the molten material comprising an axially adjustable needle mounted in co-axial first and second bushings, said bushings being slidably mounted in a housing, the housing at its forward end being adapted for insertion into the rear of the machine's hot runner panel, means for inter-connecting said first bushing to said second bushing after insertion in the housing, said first bushing having, at its forward end, protruding abutment means for engaging the forward end of the housing in the open, retracted position of the needle, said second bushing having, at its forward end, protruding abutment means for engaging the closed extended position is arranged to rest with its front end against the housing and with its rear engaging one end of the spring means, the other end of said spring means engaging a spring support axially adjustably inserted in the housing from the rear.

In this specification the terms "front", "forward" and "rear" are used in relation to the direction of feed of moulding material through the valve, i.e. the material flows from the "rear" towards the "front" or "forward" end.

The above defined needle valve has the advantages that it may easily be inserted as a complete unit, removed as well as adjusted from the rear of the hot runner panel without disassembling the same from the dies of the moulding machine.

The needle valve is also of a simple and reliable construction and may have small dimensions in the plane perpendicular to its axis. The needle valve also seals the molten

material under high pressure from the interior movable parts of the needle valve and tends to avoid problems caused by solidified particles of the molten material preventing the movable needle from locating in its proper end position.

Reference is now made to the accompanying drawings, in which:-

Figure 1 is a sectional view of a hot runner panel with a die and a co-operating needle valve inserted in the panel;

Figure 2 is a part sectional view of the needle valve;

Figure 3 is an exploded view of the parts forming the valve shown in Figure 2; and Figure 4 is an enlarged sectional view of the discharge orifice and the tip of the needle.

The use of the preferred embodiment of the needle valve according to the present invention is illustrated generally in Figure 1. A hot runner panel 1 is provided with a supply tube 2 for molten material distributing channel 3 and a heater 4. A part of a die is shown generally by 5 and in the central part of the bottom 6 of the die-cavity is provided an orifice for injection of the molten material which under high pressure is supplied through the pipe 2, the distributing channel 3 and an injection nozzle 8 which is of a material with high thermal conductivity such as e.g. copper, and which is screwed into the hot runner panel.

A needle valve generally indicated by 10 is inserted to extend co-axially with the nozzle 8 from the rear into the hot runner panel 1 by means of screw thread stud 9. The components screwed into the hot runner panel 1 are sealed by means of packing rings 11. By proper adjustment the forward flat end-surface of the needle 27 of the needle valve is arranged to be flush with the bottom 6 of the die when in the closed position. By initiating the injection the pressure of the molten material will force the needle a distance generally about 1/8" backwards to open the orifice for injection of molten material into the die and when the pressure ceases the spring means (hereinafter described) will return the needle to its closed position.

The needle valve is shown in Figures 2-4 and comprises a valve-housing 12 at its forward end provided with the screw thread stud 9 and with a central bore 13 in which there is slidably mounted a first bushing 14, which at its forward end is provided with a protruding flange 15. The bore 13 at its forward end has a counter-bore 16 wherein the flange 15 is displaceable in an axial direction with some radial clearance.

To the rear of the bushing 14 a second bushing 17 is attached which at its forward end has a protruding flange 18. The two bushings 14 and 17 are mutually connected after being placed in the housing by inserting a setscrew 19 through a screw-threaded

passage 20 in the flange 18. To make this possible the housing 12 is provided with a passage 21.

A helical spring 22 surrounding the bushing 17 rests with its forward end against the flange 18 and is held in position by means of a screw-threaded tube-like spring support 23 which at its rear end is provided with an internal flange 24 having a central aperture 25. The central aperture 25 is of hexagonal cross-section so that the spring support 23 may be screwed in position by means of a hexagonal key to compress the spring. When the spring support is in the desired position it is locked by means of a setscrew 26 which may also be arranged to be operated by a hexagonal key.

The needle 27 has at its rear extremity a protruding thread 28 and in the rear surface a bore having an hexagonal cross-section for reception of a hexagonal key. The needle is arranged for being inserted in the bushings 14 and 17 from the rear of the spring support through the aperture 25 and screwed into a corresponding internal thread in the bushing 17, until it has reached a desired axial position. It is locked in this position by screwing in a lock screw 29 which may also be arranged for operation by a hexagonal key. To ensure that the needle will maintain its position by screwing in the lock screw 29 the front of the same is ground planar and similarly the rear end of needle 27 is ground planar. Further the bushings 14 and 17 are locked against rotation in relation to housing 12 by inserting a tap 30 in the same, said tap being slideable in a groove 31 cut out in the flange 18 in axial direction.

For inserting needle valve in the rear of the hot runner panel 1 the valve housing may be provided with peripherically arranged holes 32 for co-operating with a special key (not shown in the drawing) or the rear end of the housing may be shaped to provide a hexagonal nut 33.

The forward end of the needle 27 is cylindrical and its diameter corresponds to that of the die's inlet orifice.

As shown in Figure 2, the needle 27 is normally at its extended position whereat the front face of flange 18 is in abutment with the housing 12. When pressurised molten material is passed along duct 3, the needle 27 is moved to its retracted position which is limited by flange 15 sealingly abutting against end face of bore 16.

It is envisaged that instead of the helical spring 22 shown, another form of springs e.g. Belleville-springs may be used. Additionally, the parts arranged for being operated by a hexagonal key may be arranged for being operated by other forms of tools, e.g. screwdrivers. Also the counter-bore 16 may be omitted so that the rear surface of the flange 15 in the retracted position of the

needle may seal directly against the front surface of the screw thread stud 9.

The needle valves described above provide a satisfactory solution to the problems associated with conventional valves.

WHAT I CLAIM IS:

1. A needle valve for use in an injection moulding machine's discharge orifice to a die which valve is arranged to be closed by spring means and opened by the pressure of the molten material, comprising an axially adjustable needle mounted in co-axial first and second bushings, said bushings being slideably mounted in a housing, the housing at its forward end being adapted for insertion into the rear of the machine's hot runner panel, means for inter-connecting said first bushing to said second bushing after insertion in the housing, said first bushing having, at its forward end, protruding abutment means for engaging the forward end of the housing in the open, retracted position of the needle, said second bushing having, at its forward end, a protruding flange which in the needle's closed extended position is arranged to rest with its front end against the housing and with its rear engaging one end of the spring means, the other end of the said spring means engaging an axially adjustable spring support inserted in the housing from the rear.
2. A needle valve according to claim 1 wherein the abutment means on the front end of the first bushing is a flange, the rear side of which is adapted to mate with a corresponding surface of the housing.
3. A needle valve according to claim 2 wherein the housing at its forward end has a counter-bore, wherein the flange on the first bushing is displaceable in an axial direction with some radial clearance and the bottom of the counter-bore is machined for sealing engagement with the rear of the flange when the needle is in its open, retracted position.

4. A needle valve according to Claim 1, 2, or 3 wherein the forward end of the needle is cylindrical with a diameter corresponding to that of the die's inlet orifice.

5. A needle valve according to any of Claims 1 to 4 wherein the needle is provided at its rear end with a protruding thread so that the needle can be inserted in the second bushing from the rear and screwed into a corresponding internal thread in said second bushing.

6. A needle valve according to Claim 5 wherein a lockscrew is inserted in said second bushing to lock the needle when in the desired position.

7. A needle valve according to any of Claims 1 to 6 wherein a flange on the second bushing at its periphery has an axially extending groove for co-operating with a tap inserted in the housing to restrain the second bushing from rotating within the housing.

8. A needle valve according to Claim 7 wherein the rear end of the first bushing is arranged to be received in the front end of the second bushing, a setscrew being provided which is screwed in a screw-threaded radial bore in the flange of the second bushing for locking this to the rear end of the first bushing when inserted in said second bushing.

9. A needle valve according to claim 8 wherein the housing is provided with a passage for inserting the setscrew into the flange of the second bushing.

10. A needle valve for an injection moulding machine substantially as described with reference to and as illustrated in the accompanying drawings.

11. An injection moulding machine including a needle valve according to any preceding claim.

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2. A needle valve according to claim 1 wherein the abutment means on the front end of the first bushing is a flange, the rear side of which is adapted to mate with a corresponding surface of the housing.
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