

A DEVICE FOR INJECTION MOLDING OF PLASTIC MOLDED PARTS

Description:

The invention concerns a device for the injection molding of parts made of plastic, comprising an injection molding machine and a tool dedicated thereto, where the tool contains at least two cavities that correspond to the dimensions of the molded parts to be produced, where the tool is composed of at least three parts that are able to move in relation to each other, and in the working position are firmly pressed together along separation planes that pass through the cavities and are parallel to each other and at right angles to the moving direction of the parts, where each separation plane runs through at least one cavity, and where the tool contains at least one channel for the introduction of molten plastic, which on the one hand ends in the cavities and the other in an inlet area on the surface of the tool, and in the working position is connected to the injection molding machine (German magazine "Plastics 84", (1994) 10, pages 1375 to 1382).

Injection molding machines are used to produce molded parts of almost any shape. The respective tool only needs to include cavities into which molten plastic can be injected. In the working position for example, the parts of the tool that are separated by a separation plane are firmly pressed together hydraulically. After the plastic has been injected into the cavities of the tool, it usually remains closed in the conventional technique, until the molded parts in the cavities have sufficiently cooled and solidified so

that they can be removed from the tool. To that end the tool is opened along the separation plane and its parts are separated from each other. During the time when the plastic of the molded parts cools, the injection molding machine is not used. This disadvantage is particularly significant when relatively thick-walled molded parts which require an extended cooling period are being produced.

The output of an injection molding machine can be increased if a tool is used that works in tandem according to the cited German magazine "Plastics 84". In an injection molding machine that operates with such a tool, the parts alternately open along two separation planes. During the cooling time of the molded parts in one separation plane, the molded parts can be removed from the other separation plane. This operation is advantageous for molded parts with a cooling period that is longer than the metering time needed to fill the cavities. Injection molding machines which operate in tandem are very special expensive machines. They require a moveable central plate that is installed in the middle, and to which the injection molding unit is laterally attached. The molten plastic is injected into the respective cavities through channels located in the central plate. This known tandem technique cannot be installed in conventional injection molding machines, or only after extensive rebuilding.

The object of the invention is to design the above described device in a way so that the output of finished molded parts can be increased in a simple manner, even when conventional injection molding machines are being used. The invention achieves this object in that:

- the tool is equipped with a channel that extends from the inlet area to a first separation plane, and then continues to

- the second separation plane, and has partial channels which extend to the cavities; and
- the parts of the tool are equipped with a lock which can be adjusted between two positions, where in a first position only a central part and a front part containing the inlet area of the channel are locked together, and in a second position only the central part and a rear part of the tool are locked together.

This device can be used in conventional, commercial injection molding machines without the need for rebuilding or special additional measures. It only requires that a simple tool, which was used until now and contains only two parts separated by one separation plane be replaced with the new tool that contains three parts and has two separation planes. Similar to the described tandem technique, this tool increases the output of molded parts in that, while the molded parts in the area of one of the separation planes are being removed, the plastic that was injected into the cavities of the other separation plane is cooling. The lock used for the parts of the tool during the respective cooling phase is of considerable significance for this device. It can easily be adjusted between two positions. While two parts of the tool are locked together and maintain a firm residual force, the molded parts are cooling and the separation plane of the third part can simultaneously be opened to remove finished molded parts. After this separation plane has been closed and plastic has been injected into its cavities, the lock is brought into its second position while the tool is still securely locked. The two parts of the tool with the newly filled cavities then remain tightly locked together, while the previously locked separation plane can now be opened to remove the molded parts that have cooled in the meantime, as soon as the pressure force which acts on the tool

during the injection process is lifted.

The mentioned task for the design of the lock in addition is solved according to the features

- That, fixed at the centre part of the tool, there is at least one drive with at least one slide projecting in direction of the tool's axis, which is adjustable between two end points by the drive into two opposite directions in its longitudinal direction,
- That at the tool in the area of each separation plane level is additionally arranged respectively at least one clamp device, of which respectively one first part is fixed at the centre part of the tool, while a second part interacting with the corresponding first part is attached at the front part on the one hand and at the back part of the tool on the other hand,
- That at the front part and at the back part of the tool as second part of the clamp device respectively is attached at least one holder which projects in direction of the tool's axis, which, while the tool is closed, extends into the respective first part of the clamp device, and is equipped at this end with at least one clamp body, and
- That the slide respectively in one of its end positions, for the locking operation of the clamp body, meshes with the respective clamp device.

This lock is build up extremely simple. It comprises in principle only a drive with a slide and two clamp devices, with which the slide meshes alternately. To realise an effective lock between respectively two parts of the tool the drive only has to push the slide into one of the clamp devices, at the respective close position , so that their clamp body is

pushed into the locking position. At the respective locking position, the slide is pulled out of the clamp device in the area of the respective other separation plane, so that the tool can be opened in this separation plane.

The drive can be operated with advantage automatically. This can be carried out by a pneumatically or electrically working drive. At preference a hydraulic drive will be used.

The lock consisting of drive with slide and clamp device can be mounted advantageously and space saving within the profile of the tool. Therefore the external dimensions of the tool are not enlarged by the parts of the lock. Dependent on the size of the tool are arranged advantageously at least two locks at two opposite facing sides of the tool.

Embodiments of the subject of the invention are shown in the drawings.

They show:

Fig1: the device according to the invention in schematic illustration in a partial section in close position

Fig 2+3: two different open positions of the device according to Fig1

Fig 4: a lock useable in the device in principle description

Fig 5: a different embodiment of the device in comparison to Fig 4

Fig 6 and 7: the device of Fig 5 according to the open positions of Fig 2 and 3

Fig 8: a hold to be used for the device in enlarged scale

Fig 9: a cut through fig 8 along the line IX-IX

In the drawings only those parts of an injection molding machine are shown that are necessary for the understanding of the invention. In principle known elements of this device, as for example the opening- and closing mechanism or cooling channels or heating equipments, are not shown. In Fig 4 to 7 shadings for cut parts are omitted for more clarity

The injection molding device in Fig. 1 comprises an injection molding machine 1 and a tool 2 which can be connected thereto. The injection molding machine 1 may be a conventional, commercial machine without any optional equipment. It can move in the direction of double arrow 3.

The tool 2 is composed of three parts, a front part 4, a central part 5 and a rear part 6. A pressure plate 7 closes off the rear part 6 and is connected to a pressure generator 8. The pressure generator 8 can be a hydraulic or pneumatic press, for example. The three parts of tool 2 are separated from each other by two parallel running separation planes 9 and 10. Each separation plane 9 and 10 contains at least one cavity 11 or 12 of tool 2, and their internal dimensions correspond to the geometric shape of the molded parts to be produced. The illustrated embodiment has two cavities 11 or 12 in each separation plane 9 or 10.

A channel 13 is centrally located in the tool 2 and is used to supply molten plastic to the cavities 11 and 12. The channel 13 begins in an inlet area 14 which is open to the outside and is located in a surface of the tool 2. It first extends to separation plane 9 in part 4 of the tool 2, and then continues to separation plane 10 in the central part 5 of the tool 2. As shown in the drawing, the channel 13 has a conical shape in both sections so that the molded plastic material can easily be removed from the channel 13 after cooling. Partial channels 15 or 16 come from the channel 13 and extend to the cavities 11 or 12. The partial channels 15 or 16 are preferably located in the separation planes 9 and 10.

As shown for example in Figs. 4 and 5, a lock with a bolt 17 is located on the outside of tool 2 and can be adjusted between two positions as indicated by the double arrow 18. In the position of the bolt 17 shown in Fig. 4, the parts 5 and 6 of the tool 2 are locked together, while in its second position shown in Fig. 5 the parts 5 and 4 of said tool 2 are locked together. A more precise construction of the locks that can be used with the device is described below by means of Figs. 4 to 6.

The device in Fig. 1 operates as follows:

The three parts 4, 5 and 6 of the tool 2 abut to each other in working position. They are pressed against each other by the pressure generator 8, and all three together against a stationary retaining plate 17, to which the front part 4 of tool 2 is secured. In order to produce molded parts in cavities 11 and 12, the injection molding machine 1 is moved up to the inlet area 14 of the channel 13 in tool 2. Molten plastic, which is located in the injection molding machine 1, is then pressed into the channel 13. It fills the cavities 11 and 12 via the channel 13 and the partial channels 15 and 16. Once the cavities 11 and 12 have been filled when sufficient pressure is used, the injection molding machine 1 is closed. The plastic in tool 2 is then allowed to cool.

After an adequate cooling period, the injection molding machine 1 is pulled away from the tool 2 and the latter is opened along separation plane 9. At this point its parts 5 and 6 are still locked together. They can be brought into the position shown in Fig. 2 together with the moveable pressure plate 7, after the pressure force produced by the pressure generator 8 has been turned off. The lock in this case is so advantageously designed that after the pressure force of pressure generator 8 has been turned off, a residual force remains to keep the two parts of tool 2 together. The molded parts in the cavities 11 can now be removed from the tool 2. Any plastic remaining in the channel 13 in part 4 of the tool 2 can then be removed by means of compressed air for example, so that this part of the channel 13 is made available again.

After that the tool 2 is again placed in the closed or working position shown in Fig. 1, where the parts 4, 5 and 6 of the tool 2 are firmly pressed together by the pressure generator 8. The injection molding machine 1 is again moved toward the tool 2 and the cavities are once again filled with plastic. Subsequently the lock is brought into its second position where the parts 5 and 4 of tool 2 are locked together as

described earlier. The tool 2 then opens along separation plane 10, where only its rear part 6 with the pressure plate 7 moves into the position shown in Fig. 3. The finished molded parts in the cavities 12 and any remaining plastic in the channel 13 of the central part 5 of tool 2 can be removed. During this period the plastic in cavities 11 of separation plane 9 cools.

As already described, the tool 2 is again placed into its closed or working position shown in Fig. 1. Any plastic remaining in the channel 13 portion of part 4 can be removed again with compressed air for example. The injection molding machine 1 is moved once more toward the tool 2. The cavities 12 are again filled with plastic and parts 5 and 6 are locked together again. In the meantime the molded parts in the cavities 11 have cooled so that the tool 2 can be opened along separation plane 9 as described earlier. In this way the cavities 11 and 12 are always and alternately filled with plastic and emptied after cooling.

The cooling of the plastic in cavities 11 and 12 requires that the pertinent two parts of the tool 2 remain locked together after the pressure force provided by pressure generator 8 has been turned off. To that end a lock that maintains a residual force can be used, which is present at least on one side of the device, but is more advantageous if it is present on at least two different sides thereof. For example a lock as shown in Figs. 4 to 7 can be used.

The locking mechanism consists according to the schematic illustration in Fig 4, in which the tool 2 of the device is shown partly in close- and operating position, of a drive 19, equipped with an almost rod shaped slide 18, and of two broken line framed clamp devices K, each of which having two parts. The slide 18 proceeds in direction of the axis of the tool 2. It is movable in this direction between two end positions. To each clamp device K belongs as a first part a holder 20 or 21 which extends in

the direction of the axis of tool 2 of which holder 20 is attached at the front part 4 and holder 21 is attached at the back part 6 of tool 2.

As second parts of the clamp devices K stops 22 and 23 on the one hand and 24 and 25 on the other hand respectively are attached at the centre part 4 of tool 2 in the area of the separation planes 9 and 10. Per clamp device K at least one stop respectively is needed. The gap between the stops corresponds respectively to the width of one holder 20 or 21, which as first part in the respective locking position of the tool parts meshes with the second part, which are the stops of the clamp devices K, and in the course of this being pushed in between the two stops. Every holder 20 or 21 has at its free end two clamp bodies R – at least one clamp body R has to be there – which are mounted at the respective holder and are movable transverse to the longitudinal direction of the same.

The clamp bodies R preferably are formed as rollers or cylinders and freely rotatable as well as sidewise adjustable, transverse to the axis of tool 2, fixed to the respective holder 20 or 21. In resting position they are positioned within the profile of the holders, as shown in Fig 4 at the right side for the holder 20, and they are moved outward by the slide 18 such that they mesh in locking position of tool 2 behind the stops, as shown in Fig 4 left side for the holder 21 and the stops 24 and 25.

The slide 18 is movable in direction of the double arrow 26 – that means in opposite directions – between two end positions. In one of the end positions, shown in Fig 4, the slide 18 meshes with the clamp device K in the area of separation plane 10, so that the centre part 5 and the back part 6 of tool 2 are locked with each other. As already mentioned, the slide 18 has pushed the rollers R laterally out of the holder 21, so that they are positioned behind the stops 24 and 25. As the rollers R are mounted freely rotatable and laterally movable in holder 21, they will,

without the in-between lying slide 18, while pulling the holder 21 out of the stops 24 and 25, be moved again by the stops 24 and 25 into the resting position in the respective holder, as shown for the holder 20.

The interaction of the clamp devices K and slide 18 is described for example with the help of Fig 8 and 9, in which the end part of the holder 20 is shown in an enlarged scale.

At its end intended for the mesh into the clamp device K, holder 20 has approximately centric a slit shaped recess 27 extending in its longitudinal direction, with which meshes the slide 18 in locking position of the clamp device K. The recess 27 in the shown embodiment is open to the outside at two positions opposite to each other. At these positions two clamp bodies R, constructed as rollers are attached freely rotatable and movable transverse to the longitudinal direction of the holder 20. For that they can show at their front surfaces circle shaped recesses, into which pins 28 extend, that are fixed to holder 20. The illustrated upper roller is integrated into the profile of holder 20, so that it can pass stop 22. The lower roller is pushed out of holder 20 by the slide 18, indicated with a broken line, so that in locking position it lies behind stop 23.

Each holder 20 and 21 needs in principle only one clamp body R. At part 5 of tool 2 then only one stop is needed respectively. For symmetry reasons the described embodiment with respectively two clamp bodies R and two corresponding stops is of advantage. The clamp bodies R can have, beside the mentioned shape of a roller or cylinder, any other geometric shape.

In the preferred embodiment two separate clamp devices K are attached at each side of tool 2, as shown in Fig 5 for one side of the tool 2. An unwanted opening of the tool 2 in the separation planes 9 and 10 during

the locking phase is therefore almost absolutely impossible. Drive 19 in this embodiment is equipped with two slides 18, attached to a common support 29 and therefore being moved synchronously by drive 19.

The above described locking mechanism operates – starting at the operating position of the device according to Fig 5 - for example as follows:

Before the pressure generator 8 is switched off, according to Fig 5 the two parts 5 and 6 of tool 2 are locked with each other. For that the two slides 18 have been pushed by drive 19 between the rollers R of the two holds 21. The parts 5 and 6 of tool 2 therefrom are held together with a sufficient remaining power after having switched off the pressure generator 8. To open the mold for removing the molded bodies available in the cavities 11, tool 2 can now be opened in separation plane 9, as shown analogue to Fig 2 in Fig 6.

After removal of the moulded bodies from the cavities 11 tool 2 will be closed again, and into the cavities 11 plastic material can be injected again while the pressure generator 8 is active. Before the cavities 12 of separation plane 10 are opened, the locking of the front part 4 and the centre part 5 of tool 2 is made effective. Drive 19 moves the slide 18 therefore into its other end position, in which it pushes rollers R of holders 20 outward, so that they will be positioned behind the stops 22 and 23. This locking position of tool 2 with simultaneous open separation plane 10 is shown analogue to Fig 3 in Fig 7.

Claims

1. A device for the injection molding of parts made of plastic, comprising an injection molding machine and a tool dedicated thereto, where said tool contains at least two cavities that correspond to the dimensions of the molded parts to be produced, where the tool comprises at least three parts which are moveable in relation to each other, and in the operating position are firmly pressed against each other along separation planes that pass through the cavities and are parallel to each other and at right angles to the moving direction of the parts, where each separation plane runs through at least one cavity, and where the tool contains at least one channel for supplying molten plastic, which on the one hand ends in the cavities and on the other on the surface of the tool which in the operating position is connected to the injection molding machine, **characterized in that**

a channel (13) is provided in the tool (2) and extends from the inlet area (14) to a first separation plane (9), and continues to the second separation plane (10) where partial channels (15,16) extend from it to the cavities (11,12), and a lock, which can be adjusted in two positions, is located on the parts (4,5,6) of the tool (2), where in a first position only a centre part (5) and the front part (4) of the tool (2) that contains the inlet area (14) of the channel (13) are locked together, and in a second position only the centre part (5) and a back part (6) of the tool (2) are locked together.

2. A device for the injection molding of plastic bodies, comprising an injection molding machine and a tool dedicated thereto, where said tool contains at least two cavities that correspond to the dimensions of the molded parts to be produced, where the tool comprises at least three parts which are moveable in relation to each other, a front part, a centre part and a back part, which in the operating position are firmly pressed against each other along separation planes by a pressure generator, where the tool contains at least one channel for supplying molten plastic, which

on the one hand ends in the cavities and on the other on the surface of the tool which in the operating position is connected to the injection molding machine, where a lock is attached to the parts of the tool, which can be adjusted in two positions, where in a first position only the centre part and the front part of the tool that contains the inlet area of the channel are locked together, and in a second position only the central part and the back part of the tool are locked together, **characterized in**

- that at the centre part (5) of tool (2) at least one drive (19) with at least one in direction of the axis of the tool (2) proceeding slide (18) is attached, which is adjustable between two end points by the drive (19) in two opposite directions in its longitudinal direction,
- that at the tool (2) in the area of each separation plane (9,10) is additionally arranged respectively at least one clamp device (K), of which respectively one first part is fixed at the centre part (5) of the tool (2), while a second part interacting with the corresponding first part is attached at the front part (4) on the one hand and at the back part (6) of the tool (2) on the other hand,
- that at the front part (4) and at the back part (6) of the tool (2) as second parts of the clamp device (K) respectively is attached at least one holder (20,21) which projects in the direction of tool's is (2) axis, which, while the tool (2) is closed extends into the respective first part of the clamp device (K) and is equipped at this end with at least one clamp body (R), and
- that the slide (18) respectively in one of its end positions for the locking operation of the clamp body (R) meshes with the corresponding clamp device (K).

3. A device according to claim 2, **characterized in** that in the area of each separation plane (9,10) two separate clamp devices (K), arranged on top of each other, and two slides (18) are attached at the tool (2).
4. A device according to claim 2 or 3, **characterized in** that at the ends of the holders (20,21) which in locking position of the tool (2) mesh with the corresponding parts of the clamp devices (K), at least one transverse to the axis direction of the tool (2) movable clamp body (R) is attached, which lies in locking position behind a fixed stop (22,23,24,25) and is attached at the centre part (5) of the tool (2) and forming the first part of the respective clamp device (K).
5. A device according to claim 4, **characterized in** that the clamp body (R) is built up as a roller or cylinder, able to rotate freely around its own axis.
6. A device according to claim 4 or 5, **characterized in** that at two each other facing sides of the holder (20,21) respectively one clamp body (R) is attached and that at the centre part (5) of the tool (2) respectively two corresponding stops (22,23 / 24,25) are attached.