DECELERATED EJECTOR PIN

Publication Classification

In combination with an ejector half of an injection mold for producing a part, the ejector half having a core plate, a pin plate, an ejector bar, a spring disposed in the ejector bar and at least one fixed ejector pin, a decelerated ejector pin. The decelerated ejector pin includes a first shank portion configured for corresponding to a bore formed in the core plate. A second shank portion is adjacent the first shank portion. The second shank portion is configured to correspond to a bore formed in the pin plate. The second shank portion has a shoulder for engaging the core plate during an ejection stroke of the ejector bar. A third shank portion is adjacent the second shank portion. The third shank portion is configured for retaining the decelerated ejector pin in the pin plate and for compressing the spring when the shoulder engages the core plate.
DECELERATED EJECTOR PIN
CROSS REFERENCE TO RELATED APPLICATION

[0001] This is a continuation-in-part of application Ser. No. 10/893,663, filed on Jul. 16, 2004, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates to an apparatus for de-molding injection molded parts, more specifically, to an injection mold which requires lifters to de-mold the part, has a part cavity that is shallower than the lifter cavity depth, requires a controlled ejection due to the part geometry (i.e.: part texture or cavity depth), or has limited space in the ejection system. The invention also relates to a method for ejecting a part having an embedded ejector pin.

[0004] 2. Description of the Related Art

[0005] It is prior-art practice, for example, in the case of injection molds, which use lifters to create desired part features, to use embedded ejector pins to hold a molded part stationary in the lifter de-molding axis. The embedded ejector pin allows the molded part to separate from the lifter. This practice has the disadvantage that the molded part is stuck to the embedded pin at the end of the ejection cycle. A molded part that is not ejected is very disadvantageous because it can lead to a disruption of the cycle, defective part(s) when the injection mold closes on the non-ejected part, and thus a lower productivity.

[0006] In order to deal with this problem several solutions have been proposed in the prior art. One solution is to use an air blow-off to blow the part off of the embedded ejector pin. This solution has the disadvantages that there is no control of the part when it is blown off and that air blow-offs generate dirt in the injection mold. Another solution is the use of a robot to remove the parts. This solution has the disadvantages of a large capital expense, longer cycle times, and additional maintenance costs. A third solution is to have an operator manually remove the parts. This solution has the disadvantages of inconsistent cycle times, longer cycle times, and additional labor costs.

[0007] Accordingly, prior art ejector systems have the disadvantages that they do not provide a satisfactory solution for removing an embedded ejector pin from a molded part.

SUMMARY OF THE INVENTION

[0008] It is accordingly an object of the invention to provide a decelerated ejector pin and decelerated ejector system which overcome the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and which provides an ejector system for a mold requiring embedded ejector pins that is easily manufactured, easy to maintain, is durable, and reliable.

[0009] With the foregoing and other objects in view there is provided, in accordance with the invention in combination with an ejector half of an injection mold for producing a part, the ejector half having a core plate, a pin plate, an ejector bar, a spring disposed in the ejector bar and at least one fixed ejector pin, a decelerated ejector pin. The decelerated ejector pin includes a first shank portion configured for corresponding to a bore formed in the core plate. A second shank portion is adjacent the first shank portion. The second shank portion is configured for corresponding to a bore formed in the pin plate and has a shoulder for engaging the core plate during an ejection stroke of the ejector bar. A third shank portion is adjacent the second shank portion. The third shank portion is configured for retaining the decelerated ejector pin in the pin plate and for compressing the spring when the shoulder engages the core plate.

[0010] In accordance with another feature of the invention, a fourth shank portion is adjacent the third shank portion. The fourth shank portion is configured for passing through an inside diameter of the spring.

[0011] In accordance with a further feature of the invention, the first shank portion has a first diameter. The second shank portion has a second diameter greater than the first diameter. The third shank portion has a third diameter greater than the second diameter. The fourth shank portion has a fourth diameter smaller than the third diameter.

[0012] In accordance with an added feature of the invention, the shank portions each have a respective length. The lengths are configured for allowing the decelerated ejector pin to hold the part until the part is clear of the ejector half during the ejection stroke and the lengths are configured for allowing the decelerated ejector pin to be de-molded from the part by compressing the spring as the at least one ejector pin reaches the end of the ejection stroke.

[0013] In accordance with an additional feature of the invention the fourth shank portion is configured to correspond to a bore formed in the ejector bar and to engage the base plate in a clamped position of the injection mold.

[0014] In accordance with yet another feature of the invention, the second shank portion is a removable sleeve having an inner diameter corresponding to the first diameter.

[0015] With the objects of the invention in view, there is also provided in an ejector half of an injection mold, for molding a molded part, a core plate, a pin plate, an ejector bar, a base plate, and at least one fixed ejector pin, a decelerated ejector pin system. The decelerated includes at least one further ejector pin to be moved and decelerated through the core plate. A shoulder is formed on the further ejector pin to engage the core plate for decelerating the further ejector pin during an ejection stroke of the ejector bar. A spring is disposed in the ejector bar. A further shoulder is formed on the further ejector pin for supporting the further ejector pin and compressing the spring.

[0016] In accordance with yet a further feature of the invention, the further ejector pin has a shank portion that has a diameter adjacent the further shoulder. The shank portion is configured to correspond to an inner diameter of the spring.

[0017] In accordance with yet an added feature of the invention, the further ejector pin is longer than the at least one fixed ejector pin.

[0018] In accordance with yet an additional feature of the invention the shank portion is configured to engage the base plate in a clamped state of the injection mold.
[0019] It is noted that fact that the present invention as claimed is capable of operating in a myriad of different injection molds, where each mold has different dimension for the plates, lifter, cavity details, ejection stroke etc. Therefore, it is not possible to list the specific dimensions for different molds. The claims have been made as accurate as the subject matter permits. This is supported by the fact that a claim limitation specifying that a certain part of a pediatric wheelchair be “so dimensioned as to be insertable through the space between the doorframe of an automobile and one of the seats” was held to be definite. Orthokinetics Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1 USPQ2d 1081 (Fed. Cir. 1986). The court stated that the phrase “so dimensioned” is as accurate as the subject matter permits, noting that the patent law does not require that all possible lengths corresponding to the spaces in hundreds of different automobiles be listed in the patent, let alone that they be listed in the claims.

[0020] Other features which are considered as characteristic for the invention are set forth in the appended claims.

[0021] Although the invention is illustrated and described herein as embodied in a decelerated ejector pin system and a method of using the same, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

[0022] The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is a diagrammatic, partial-sectional view of the ejector half of an injection mold according to the invention in a clamped state prior to plastic injection phase, including basic components of the ejector half of the mold;

[0024] FIG. 2 is a partial-sectional view of the ejector half of the mold according to FIG. 1 after injection of plastic during a cooling phase;

[0025] FIG. 3 is an enlarged sectional view according to FIG. 1 of a portion of a decelerated ejector pin embedded in the molded part;

[0026] FIG. 4 is a partial-sectional view of the ejector half of the mold according to FIG. 1 during a first stage of ejection, where the decelerated ejector pin de-molds a molded part from a lifter cavity detail;

[0027] FIG. 5 is a partial sectional view of the ejector half of the mold according to FIG. 1 during a second stage of ejection, where the lifter cavity detail is completely de-molded and the decelerated ejector pin is initially decelerated;

[0028] FIG. 6 is an enlarged sectional view according to FIG. 1 of an embedded portion of the decelerated ejector pin after the deceleration of the decelerated pin has been initiated;

[0029] FIG. 7 is a partial-sectional view of the ejector half of the mold according to FIG. 1 during a third stage of ejection, where the molded part is completely de-molded from the decelerated ejector pin;

[0030] FIG. 8 is an enlarged sectional view of the decelerated ejector pin according to FIG. 1 during the third stage of ejection, as shown in FIG. 7, where the molded part is completely de-molded from the decelerated ejector pin;

[0031] FIG. 9 is a partial-sectional view of the ejector half of the mold according to FIG. 1 where the molded part is completely clear of the injection mold and the ejection system is ready to return to the clamped state to complete the cycle;

[0032] FIG. 10 is an enlarged sectional view of the decelerated ejector pin system according to FIG. 1 during the injection stage of the cycle, where the part is ready to be molded;

[0033] FIG. 11 is a sectional view of both halves of an injection mold showing the decelerated ejector pin system according to FIG. 1 during the injection stage of the cycle, where the part is ready to be molded;

[0034] FIG. 12 is a diagrammatic, partial-sectional view of the ejector half of an injection mold according to another embodiment of the invention in a clamped state prior to plastic injection phase, including basic components of the ejector half of the mold;

[0035] FIG. 13 is a partial-sectional view of the ejector half of the mold according to the embodiment of FIG. 12 during a third stage of ejection, where the molded part is completely de-molded from the decelerated ejector pin;

[0036] FIG. 14 is a side view of the decelerated ejector pin according to the embodiment of FIG. 12; and,

[0037] FIG. 15 is a diagrammatic, partial-sectional view of the ejector half of an injection mold according to yet another embodiment of the invention in a clamped state prior to plastic injection phase, including basic components of the ejector half of the mold.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Referring now to the figures of the drawing in detail and first, particularly to FIG. 1 thereof, there is seen part of an ejector half 41 of an injection mold 45 (FIG. 11) according to the invention. The injection mold 45 can be used in any common injection-molding press (not illustrated) that properly corresponds to the size of the mold.

[0039] The ejector half 41 of the mold 45 includes a core plate or B-plate 13, an ejector system 40, and a bottom clamp plate or base plate 16. The core plate 13 includes a molding cavity 17, which has a depth C.

[0040] The ejector system 40, is a mechanical assembly that is free to move relative to the ejector half 41 of the mold 45 and is actuated by the injection-molding press to de-mold at least one molded part 22 (FIG. 2). The ejector system 40 includes a pin plate or retainer plate 14, an ejector bar 15, at least one lifter 11, fixed ejector pins 7, and at least one decelerated ejector pin system 18 (FIGS. 8 and 10). The ejector system 40 may also include a lifter 11. The term “decelerated” is used to indicate that when the “decelerated” ejector pin system 18 is initiated, a “decelerated” ejector pin
is mechanically stopped while the rest of the ejection assembly continues to move to complete the de-molding process.

[0041] The lifter 11, a decelerated ejector pin or further ejector pin 5, and the fixed ejector pins 7 are mounted in the pin plate 14 and are actuated along an ejection axis E by the ejector bar 15, which is actuated by an ejector system of the injection molding press, to eject the molded part 22. The decelerated ejector pin 5, and the fixed ejector pins 7 slide through the core plate 13, along the ejection axis E to eject the molded part 22. The lifter 11 moves through the core plate at an angle α to the ejection axis E. The lifter 11 includes a cavity detail 12 that is molded into the molded part 22. The cavity detail 12 has a depth D, which is the depth that the cavity detail 12 creates in the molded part 22. As the press opens the mold and the lifter 11 moves out of the core plate 13, the cavity detail 12 de-molds from the molded part 22 along a lifter de-molding axis A.

[0042] The decelerated ejector pin system 18 includes a decelerated ejector pin 5 with a head 25 and a shaft 35. The decelerated pin 5 projects into the cavity 17 and is embedded into the molded part 22 to prevent the molded part 22 from moving along the lifter de-molding axis A. A sleeve 6 is provided on the ejector pin shaft 35 at the pin plate 14. The sleeve 6 has a head 26. A stop pin 3 is provided that has a head 23 and a shaft 33. The decelerated ejector pin 5 is located on the head 23 of the stop pin 3. The head 23 abuts a spring 4 that is located in the ejector bar 15 and held in place between the ejector bar 15 and the head 23 to pre-stress the stop pin 3. The shaft 33 of the stop pin 3 is located inside the spring 4. The stop pin 3 and the spring 4 are retained in the ejector bar 15 by a cap 1 and screw 2.

[0043] As can be seen in FIG. 5 the sleeve 6 mechanically stops the decelerated ejector pin 5 by making contact with a counter bore 20 provided in the core plate 13. Alternatively, it is possible to eliminate the counter bore 20 if stroke limiters (not illustrated) are used in the mold 45. The stroke limiters are required when the stroke needed to eject the part is less than the ejection stroke available. If stroke limiters are used to positively stop the pin plate 14 and the ejector bar 15 before they reach the core plate 13 the counter bore 20 can be eliminated.

[0044] FIGS. 12 and 13 show another embodiment of the invention, which includes a decelerated ejector pin 5. The embodiment shown in FIG. 12, allows for decelerated ejector pins 5 to be manufactured in different sizes by a pin supplier. The pin supplier in turn sells the pins system as a shelf item, which can be installed into the mold by the mold maker or by the molding facility. Alternatively, the pin supplier can produce the pin based on the dimensions of the components of a particular injection mold. The embodiment shown in FIG. 12 eliminates some of the components that are used in the embodiment of FIGS. 1-11, which in turn makes it easier to sell the decelerated ejector pin system as a shelf item or a made to order item.

[0045] The embodiment shown in FIGS. 12 and 13 includes the decelerated ejector pin 5. FIG. 14 shows that the decelerated pin 5 has an overall length l and several different diameters d₁-d₄. The pin has the following configuration.

[0046] The decelerated ejector pin 5 has a first shank portion 54 having a first diameter d₁, corresponding to a through hole 113 formed in the core plate 13. The first shank portion 54 has a length l₁. The decelerated ejector pin 5 has a second shank portion 55 adjacent the first shank portion 54, the second shank portion 55 has a second diameter d₂ corresponding to a through hole 114 formed in the pin plate 14. The second shank portion 55 has a length l₂. The second diameter d₂ is larger than the first diameter d₁ so that the decelerated ejector pin 5 has a shoulder 51. The decelerated ejector pin 5 has a third shank portion 56 adjacent the second shank portion 55, the third shank portion 56 has a third diameter d₃ corresponding to a to a diameter of a counterbored hole 214 in the pin plate 14. The third diameter d₃ is larger than the second diameter d₂ thereby forming a shoulder 52 that retains the decelerated ejector pin 5 in the counterbored hole 214. The third diameter d₃ has a length l₃.

The decelerated ejector pin 5 has a fourth shank portion 57 adjacent the third shank portion 56, the fourth shank portion 57 has a fourth diameter d₄. The fourth diameter d₄ is smaller than the third diameter d₃, thereby forming a shoulder 53 for compressing the spring 4 disposed in the ejector bar 15. The fourth shank portion 57 corresponds to the inside diameter of the spring 4 to pass through the spring 4 and into a hole 115 formed in the ejector bar 15. The fourth shank portion 57 has a length l₄, which allow the fourth shank portion to abut the base plate 16 in a clamped position of the injection mold. The shoulder 51 engages the core plate 13 during the ejection stroke to compress the spring 4 for decelerating the decelerated ejector pin 5. The fourth shank portion 57 may be eliminated if the spring 4 is strong enough to hold the decelerated injection pin 5 in place against the injection pressure acting on the face of the decelerated ejector pin 5, which is generated by injecting the material into the mold.

[0047] It is noted that specific dimensions of the components of the ejector pin system 18 are not provided due to the myriad of possibilities that are possible for the different dimensions thereof. More specifically, the dimensions of the decelerated ejector pin 5 are based on many features such as the part 22 configuration, dimensions of the different plates of the ejector half 41 of the mold, the ejection stroke, depth of the cavity detail 12, etc. Accordingly, the dimensions of the decelerated ejector pin 5 will be described so that the ejection pin system will function properly.

[0048] As noted above, the diameters d₁ to d₄ must correspond to the respective holes in the mold plates 13-16 and the inner diameter of the spring 4. The lengths l₁ to l₄ must be dimensioned to work with the mold plates 13-16 and the ejection stroke for allowing the decelerated ejector pin 5 to hold the part 22 long enough for the cavity detail 12 of the lifter 11 to be removed from the part 22. At the same time, the lengths l₁ to l₄ must also be dimensioned for the allowing part 22 to be de-molded from the decelerated ejector 5 as the fixed ejector pins 7 reach the end of the ejection stroke.

[0049] Alternatively, the decelerated ejector pin 5 is can also control the ejection of a part 22 that has a deep cavity depth c or in any other part where a controlled ejection of the part 22 is desired. In this situation, the decelerated ejector pin 5 must be dimensioned to remain in the part 22 until the end of the part is clear of the cavity plate 13 and to allow the part 22 de-molded from the decelerated ejector pin 5 as the fixed ejector pins 7 reach the end of the ejection stroke. Based on the above-given description, a person of ordinary skill in the art can fully understand the relationships of the lengths l₁ to l₄.
FIG. 15 shows yet another embodiment of the decelerated ejector pin system 18, which includes a decelerated ejector pin 5. The system shown in FIG. 15 is as in FIG. 12 with the exception that the second shank portion 55 is replaced with a removable sleeve 61. The sleeve 61 fits over the first shank portion 54 and abuts the shoulder 52. The use of the sleeve 61 offers the benefit that the stroke is adjustable by changing the length of the sleeve 61 while only adding one additional component to the decelerated ejector pin system 18.

The operation of the device during a molding cycle will be described with respect to the drawings and the above-provided description.

FIGS. 1, 11, and 12 show the ejector half 41 of the mold 45 in the initial stage or clamped position of the injection mold of the cycle. In the clamped position the injection mold 45 is ready to be injected with melted plastic material from the press for forming the part 22.

FIG. 2 shows that the injection mold 45 is still in the clamped position and the plastic material has been injected into the cavity 17 to form the part 22. The clamped position is maintained until the part has cooled sufficiently to be ejected. It is shown in the enlarged FIG. 3, that after the injection of plastic material is completed, the decelerated pin 5 is embedded in the part 22. Also, it is shown in FIG. 2 that the plastic surrounds the cavity detail 12 of the lifter to create the desired part feature.

FIG. 4 shows a first stage of ejection, initiated by the press, where the lifter and the ejectors begin to move out of the core plate 13. The decelerated ejector pin 5 remains embedded in the part 22, to hold the part on the decelerated ejector pin 5, which allows the lifter cavity detail 12 to move along the lifter de-molding axis A, while de-molding from the molded part 22.

FIG. 5 shows a second stage of ejection where the lifter is completely de-molded from the part 22 and the deceleration of the decelerated ejector pin 5 is initiated. The sleeve 6 makes contact with the core plate 13, which pushes down on the head 25 of the decelerated ejector pin 5. The decelerated ejector pin 5 in turn presses down on the stop pin 3, which compresses the spring 4. The fixed ejector pins 7 continue to move the part off of the decelerated ejector pin 5, which is decelerated due to the compression of the spring 4. FIG. 6 shows an enlarged view of the initiation of the deceleration of the decelerated ejector pin 5.

FIGS. 7 and 13 show a third stage of ejection, where the ejectors 7 have continued to move and decelerated ejector pin 5 is completely de-molded from the molded part 22. The spring 4 has been further compressed and the amount of deceleration P of the decelerated ejector pin can be seen. FIG. 8 shows an enlarged view of the stop pin 3 compressing the spring 4 during the third stage of ejection.

FIG. 9 shows that the momentum of the ejectors 7 has propelled the molded part 22 off of the ejectors 7 and the injection mold is ready to begin a new molding cycle.

FIG. 10 also shows an enlarged view of the decelerated ejector pin system 18 returned back to its original state ready for the injection stage of the process.

I claim:

1. In combination with an ejector half of an injection mold for producing a part, the ejector half having a core plate, a pin plate, an ejector bar, a spring disposed in the ejector bar and at least one fixed ejector pin, a decelerated ejector pin comprising:

a first shank portion configured for corresponding to a bore formed in the core plate;

a second shank portion adjacent said first shank portion, said second shank portion configured for corresponding to a bore formed in the pin plate and having a shoulder for engaging the core plate during an ejection stroke of the ejector bar; and

a third shank portion adjacent said second shank portion, said third shank portion configured for retaining the decelerated ejector pin in the pin plate and for compressing the spring when said shoulder engages the core plate.

2. The decelerated ejector pin according to claim 1, further comprising a fourth shank portion adjacent said third shank portion, said fourth shank portion is configured for passing through an inside diameter of the spring.

3. The decelerated ejector pin according to claim 2, wherein the first shank portion has a first diameter, said second shank portion has a second diameter greater than said first diameter, said third shank portion has a third diameter greater than said second diameter, said fourth shank portion has a fourth diameter smaller than said third diameter.

4. The decelerated ejector pin according to claim 3, wherein said shank portions each have a respective length, said lengths being configured for allowing the decelerated ejector pin to hold the part until the part is clear of the ejector half during the ejection stroke and said lengths being configured for allowing the decelerated ejector pin to be demolded from the part by compressing the spring as the at least one ejector pin reaches the end of the ejection stroke.

5. The decelerated ejector pin according to claim 3, wherein said fourth shank portion is configured to correspond to a bore formed in the ejector bar to and to engage the base plate in a clamped position of the injection mold.

6. The decelerated ejector pin according to claim 1, wherein said second shank portion is a removable sleeve having an inner diameter corresponding to said first diameter.

7. A decelerated ejector pin for an ejector half of an injection mold for producing a part, the ejector half having a core plate, a pin plate, an ejector bar, a spring disposed in the ejector bar and at least one fixed ejector pin, a decelerated ejector pin comprising:

a first shank portion configured for corresponding to a bore formed in the core plate;

a second shank portion adjacent said first shank portion, said second shank portion configured for corresponding to a bore formed in the pin plate and having a shoulder for engaging the core plate during an ejection stroke of the ejector bar; and

a third shank portion adjacent said second shank portion, said third shank portion configured for retaining the decelerated ejector pin in the pin plate and for compressing the spring when said shoulder engages the core plate.
8. The decelerated ejector pin according to claim 7, further comprising a fourth shank portion adjacent said third shank portion, said fourth shank portion is configured for passing through an inside diameter of the spring.

9. The decelerated ejector pin according to claim 8, wherein the first shank portion has a first diameter, said second shank portion has a second diameter greater than said first diameter, said third shank portion has a third diameter greater than said second diameter, said fourth shank portion has a fourth diameter smaller than said third diameter.

10. The decelerated ejector pin according to claim 9, wherein said shank portions each have a respective length, said lengths being configured for allowing the decelerated ejector pin to hold the part until the part is clear of the ejector half during the ejection stroke and said lengths being configured for allowing the decelerated ejector pin to be demolded from the part by compressing the spring as the at least one ejector pin reaches the end of the ejection stroke.

11. The decelerated ejector pin according to claim 10, wherein said fourth shank portion is configured to correspond to a bore formed in the ejector bar and to engage the base plate in a clamped position of the injection mold.

12. The decelerated ejector pin according to claim 8, wherein said second shank portion is a removable sleeve having an inner diameter corresponding to said first diameter.

13. In an ejector half of an injection mold, for molding a molded part, a core plate, a pin plate, an ejector bar, a base plate, and at least one fixed ejector pin, a decelerated ejector pin system, comprising:

   at least one further ejector pin to be moved and decelerated through the core plate;

   a shoulder formed on said further ejector pin engaging the core plate for decelerating said further ejector pin during an ejection stroke of the ejector bar;

   a spring disposed in the ejector bar; and

   a further shoulder formed on said further ejector pin for supporting said further ejector pin and compressing said spring.

14. The decelerated ejector pin system according to claim 13, wherein:

   said further ejector pin has a shank portion having a diameter adjacent said further shoulder, said shank portion configured to correspond to an inner diameter of said spring.

15. The decelerated ejector pin system according to claim 13, wherein said further ejector pin is longer than the at least one fixed ejector pin.

16. The decelerated ejector pin system according to claim 14, wherein said shank portion is configured to engage the base plate in a clamped state of the injection mold.