

## **Improved Mold Lock**

### **Field of Invention**

The present invention relates to the field of injection molding. More particularly, the present invention relates to a locking device for securing mold plates together.

### **Background**

In injection molding processes involving three or more mold plates which open and close in sequence, there is a need to secure a set of mold plates forming one or more cavities together after the injection of the molten material into the cavity of the mold plates and during the movement of the set mold plates that have been injected with molten material. The other mold plates are then released in order to effect the removal of the molded article.

An example of such injection molding processes is the tandem injection molding process. In the tandem injection molding process, a first and second set of mold plates are respectively secured and unsecured simultaneously to facilitate the alternate opening and closing of the mold plates. This allows for higher efficiency in the production cycle by utilizing the time taken for cooling phase of a first set of cavities to be used for the removal of the molded article and injection of molten material in a second set of cavities and vice versa.

The securing of the set mold plates together ensures that the mold plates which cavities have been injected with molten material do not open up prematurely when moving into position, or fall off the guide pin of the mold during production thereby resulting in damage to the mold plates and/or injury to the operator. For similar reasons, there is

also a need to secure mold plate sets in non-tandem processes involving three or more mold plates.

While locks for securing mold plates together are known in the prior art, it has been found that the prior art locks may be unintentionally unlocked during production. For example, prior art locks powered by faulty hydraulic actuators may open or close involuntarily during operation. The manual handling of the mold plates by the operator may also result in an accidental opening or closing of the locks or an operator may accidentally activate the controls of the locks. The unintentional unlocking of the locks when the mold plates are held together may result in the separation of the mold plates during opening, and in some situations, may result in the mold plates falling off the guide pin of the mold during production. This may result in damage to the mold plates and/or injury to the operator. Further, the accidental locking of the lock mechanism when the mold plates are separated may result in damage to the lock mechanism when the mold plates move together.

Therefore there is a need for an improved mold lock which cannot be unintentionally locked or unlocked during operation.

## **Summary**

The present invention is an improved mold lock for preventing accidental opening or closing of mold plates comprising a latch body moveable between first and second positions, at least one locking tumbler including at least one locking protrusion attached to the latch body, at least one bolt including at least one locking depression and wherein the arrangement of the locking tumbler and the bolt are such that, when the latch body is in a first position, the locking protrusion of the locking tumbler engages the locking depression of the bolt and secures the locking tumbler to the bolt, and when the latch

body is in a second position, the locking protrusion of the locking tumbler disengages the locking depression of the bolt and releases the locking tumbler from the bolt;

Preferably, the improved mold lock includes a safety device comprising a housing having a cavity, and a resilient element positioned in the cavity;

More preferably, the resilient element comprises a compression spring;

Still preferably, the safety device is held in a compressed position by the bolt; and when the bolt is unlocked and moved away from said locking tumbler, the safety device is released to expand from the compressed position to an expanded position in which expanded position the safety device blocks the locking tumbler whereby the locking tumbler and latch body are prevented from movement;

Preferably, the improved mold lock further includes an actuator attached to the latch body for moving the latch body and said tumbler between first and second positions;

More preferably, the actuator is a hydraulic actuator, a pneumatic actuator, a magnetic actuator, a mechanical actuator, or an electrical actuator.

Preferably, there are first and second locking tumblers attached to the latch body, and first and second bolts which are received by the first and second locking tumblers respectively, wherein the locking protrusions of the locking tumblers and the locking depressions of the bolts are configured such that upward or downward vertical movement of the latch body between the first and second positions simultaneously secures the first locking tumbler to the first bolt and releases the second locking tumbler from the second bolt;

More preferably, the improved mold lock further includes a guide bar to which the latch body is slidably connected;

Still preferably, the guide bar is configured to move the latch body upwardly and downwardly;

Preferably, when the safety device is released to expand from a compressed position to an expanded position in which expanded position the safety device blocks the locking tumbler whereby the locking tumbler and latch body is prevented from movement along the guide bar;

More preferably, the improved mold lock is combined with first side mold plate, second center mold plate and third side mold plate;

Still preferably, the main latch body is upwardly and downwardly slidably connected to the second center mold plate and at least one said bolt is connected to each or either of the first side mold plate and third side mold plate;

Preferably, the mold plates open and close relative from each other in a pre-determined sequence.

### **Brief Description of Drawings**

Figure 1 is a perspective view of one preferred embodiment of the improved mold lock.

Figures 2 to 5 are schematic illustrations of the embodiment of the Figure 1 mold lock incorporated in a tandem type mold, and illustrating the operation of the lock in the sequential operation of the tandem type mold.

Figure 6 is a perspective view of a second embodiment of the improved mold lock.

Figures 7 to 10 are schematic illustrations of the embodiment of the Figure 6 mold lock incorporated in a 3 plate mold, and illustrating the operation of the lock in the sequential operation of the 3 plate mold in a non-tandem process.

### **Detailed Description**

As shown in Figure 1, numeral 100 generically designates one preferred embodiment of the improved mold lock of the present invention. Improved mold lock 100 includes a latch body 22, which is connected to and carries an actuator 20 such that the actuator 20 and latch body 22 both move vertically upwardly and downwardly as indicated by arrow A. Actuator 20 includes an actuator rod 21 which is connected to a stationary head 38 having head screws 36, the latter of which are connected to the center mold plate 204 as shown in Figure 2. The actuator 20 may be any type of actuator, such as a hydraulic, pneumatic, magnetic or mechanical actuator.

As further shown in Figure 1, latch body 22 includes a pair of locking tumblers 24 and 26 which receive bolts 28 and 30. Bolts 28 and 30 terminate in bolt screws 40 which, as shown in Figure 2, are connected to side mold plates 202 and 206. As further shown in Figure 2, the locking tumblers 24 and 26 are configured and shaped with locking protrusions 24a and 26a for alternately being received by and locking in locking depressions 28a and 30a provided on bolts 28 and 30 when the actuator 20 moves the latch body 22 vertically upwardly and downwardly. As shown in Figure 2, a movement of the latch body 22 to the downward vertical position secures bolt 28 to locking tumbler 24 and releases bolt 30 from locking tumbler 26. Conversely, a movement of the latch body 22 to the upward vertical position, as shown in Figure 4, secures bolt 30 to locking tumbler 26 and releases bolt 28 from locking tumbler 24.

As further shown in Figures 1 and 2, there is a pair of safety devices 32 and 34 connected to center mold plate 204 such as by a threaded connection or other known forms of connection. The safety devices 32 and 34 extend horizontally from center mold plate 204 towards a position between bolts 28 and 30 and locking protrusions 24a and 26a and are in communication with part of the bolts 28 and 30 respectively. Each of the safety devices 32 and 34 comprise a housing 35 holding a resilient element such as compression spring 35a. The safety devices 32 and 34 are held in a compressed condition by the bolts 28 and 30. Figure 2 shows locking protrusions 24a and 26a locked with locking depressions 28a and 30a and safety devices 32 and 34 being held in a compressed condition by abutment with bolts 28 and 30 respectively.

The operation of the improved mold lock 100 in the sequential operation of a tandem type mold is shown in Figures 2 to 5.

In a first step in the operation of the improved mold lock 100 as illustrated in Figure 2, all three mold plates 202, 204, 206 are in a closed position. The operation of the actuator 20 has moved latch body 22 and locking tumblers 24, 26 to the downward vertical position. Bolt 28 is locked to locking tumbler 24, and bolt 30 is released from locking tumbler 26. As a consequence, side mold plate 202 is secured to center mold plate 204.

In a second step in the operation of the improved mold lock 100 as illustrated in Figure 3, side mold plate 206 has moved away from center mold plate 204. The bolt 30 attached to side mold plate 206 has moved away from locking tumbler 26 and safety device 34. The movement of bolt 30 releases safety device 34 to move from a compressed condition of the safety device 34 to an expanded condition of the safety device 34. In the expanded condition of the safety device 34, safety device 34 blocks locking tumbler 26 such that locking tumbler 26 and latch body 22 are prevented from moving to the upward vertical position. This prevents the unintentional unlocking of side mold plate 202 and center mold plate 204 when side mold plate 206 is open.

In a third step in the operation of the improved mold lock 100, as illustrated in Figure 4, all three mold plates 202, 204, 206 are in a closed position. During the return of bolt 30 into locking engagement with locking tumbler 26, bolt 30 pushes safety device 34 from a previously expanded position to a compressed position of the safety device 34. In the compressed position, safety device 34 no longer blocks the movement of locking tumbler 26 and latch body 22 from moving to the upward vertical position. The operation of actuator 20 moves latch body 22, and correspondingly, the locking tumblers 24, 26 to the upward vertical position. Bolt 30 is locked to locking tumbler 26 and bolt 28 is released from locking tumbler 24. As a consequence, side mold plate 206 is secured to center mold plate 204.

In a fourth step in the operation of the improved mold lock 100, as illustrated in Figure 5, side mold plate 202 is separated from center mold plate 204 and side mold plate 206. The bolt 28 attached to side mold plate 202 moves away from locking tumbler 24 and safety device 32. The movement of bolt 28 releases safety device 32 to move from a previously compressed position to an expanded position. In the expanded position of the safety device 32, safety device 32 blocks locking tumbler 24 such that locking tumbler 24 and latch body 22 is prevented from moving to the downward vertical position. This prevents the unintentional unlocking of side mold plate 206 and center mold plate 204 when side mold plate 202 is open.

In a fifth step in the operation of the improved mold lock 100, as illustrated in Figure 4, all three mold plates 202, 204, 206 are in a closed position. During the return of bolt 28 into locking engagement with locking tumbler 24, bolt 28 pushes safety device 32 from a previously expanded position to a compressed position. In the compressed position of the safety device 32, safety device 32 no longer blocks the movement of locking tumbler 24 and latch body 22 from moving to the downward vertical position. The operation of the

actuator 20 then repeats the first step in the operation of the improved mold lock 100 as described above.

As shown in Figure 6, numeral 400 generically designates a second preferred embodiment of the improved mold lock of the present invention which is particularly designed for use with three plate molds which do not operate in the tandem mode. As shown in Figures 6 and 7, the latch body 402 of the improved mold lock 400 is slidably connected to a stationary guide bar 404 having a horizontal portion 404a and an angled portion 404b at cam surfaces 420. The latch body 402 is further slidably connected to the center mold plate 604 via shoulder screw 422 and slot holes 423. The movement of the latch body 402 towards the angled portion 404b of the guide bar 404 consequently moves the latch body to an upward position and conversely the movement of the latch body 402 away from the angled portion 404b of the guide bar 404 moves the latch body to a downward position. As in the first preferred embodiment, the latch body 402 includes locking tumblers 406 and 408 which are configured on one side of the latch body 402 for receiving bolts 410 and 412. Bolts 410 and 412 terminate in bolt screws 414 which, as shown in Figure 7, are connected to side mold plate 602. As further shown in Figure 7, the locking tumblers 406 and 408 are configured and shaped with locking protrusions 406a and 408a for being received by and locking with locking depressions 410a and 412a provided on bolts 410 and 412 when the latch body 402 moves downwardly to its downward position as shown in Figure 7. The locking protrusions 406a and 408a are released from the locking depressions 410a and 412a when the latch body 402 moves upwardly to its upward position as shown in Figure 8.

As further shown in Figures 6 and 7, improved mold lock 400 also includes a pair of safety devices 416 and 418 connected to center mold plate 604. The safety device 416 extends horizontally from center mold plate 604 towards a position between bolt 410 and locking protrusion 406a and is in communication with bolt 410, and the safety device 418 extends horizontally from center mold plate 604 towards a position between bolt 412 and

locking protrusion 408a and are in communication with part of bolt 412, as in the first embodiment.

The operation of the improved mold lock 400 in a sequential operation of a non-tandem three plate mold is shown in Figures 7 to 9.

In a first step in the operation of the improved mold lock 400 as shown in Figure 7, the latch body 402 is in its downward position in which locking protrusions 406a and 408a are locked with locking depressions 410a and 412a, and safety devices 416 and 418 are held in their compressed condition by bolts 410 and 412, respectively.

In the second step in the operation of the improved mold lock 400, as shown in Figure 8, the latch body 402 is moved to its upward position, and locking protrusions 406a and 408a are unlocked from locking depressions 410a and 412a.

In the third step in the operation of the improved mold lock 400, as shown in Figure 9, side mold plate 602 is separated and moved away from center mold plate 604. Bolts 410 and 412 attached to side mold plate 602 move away from locking tumblers 406 and 408 and safety devices 416 and 418. The movement of the bolts 410 and 412 releases safety devices 416 and 418 to move from their compressed condition to their expanded condition. In the expanded condition of the safety devices 416 and 418, the safety devices 416 and 418 block locking tumblers 406 and 408 such that locking tumblers 406 and 408 and latch body 402 are prevented from moving back to their downward position. This prevents the unintentional moving of the locking tumblers 406 and 408 into a locked position where locking protrusions 406a and 408a will be hit by bolts 410 and 412 when side mold plate 602 is moved back towards center mold plate 604. The blocking of the latch body 402 by the safety devices 416 and 418 also prevents the latch body 402 from moving along the angled portion 404b of guide bar 404. As such, center mold plate 604 is locked in position and prevented from moving out of a planned sequence.

In the fourth step in the operation of the improved mold lock 400, as shown in Figure 10, side mold plate 602 is moved back towards center mold plate 604 and the safety devices 416 and 418 are returned to the compressed condition by bolts 410 and 412. The latch body 402 is then free to return to the downward position to lock side mold plate 602 and center mold plate 604 together.

In a subsequent step in the operation of the improved mold lock 400, the locked mold plates 602 and 604 are moved back into contact with side mold plate 606 as shown in Figure 7. After which, the above steps may be repeated.

It is to be understood that the foregoing description of the preferred embodiment is intended to be purely illustrative of the principles of the invention, rather than exhaustive thereof, and that changes and variations will be apparent to those skilled in the art, and that the present invention is not intended to be limited other than as expressly set forth in the following claims.

## Claims

1. An improved mold lock for preventing accidental opening or closing of mold plates comprising:
  - a. a latch body moveable between first and second positions;
  - b. at least one locking tumbler attached to the latch body;
  - c. the locking tumbler including at least one locking protrusion;
  - d. at least one bolt;
  - e. the bolt including at least one locking depression; andwherein the arrangement of the locking tumbler and the bolt are such that, when the latch body is in a first position, the locking protrusion of the locking tumbler engages the locking depression of the bolt and secures the locking tumbler to the bolt;  
and when the latch body is in a second position, the locking protrusion of the locking tumbler disengages the locking depression of the bolt and releases the locking tumbler from the bolt.
2. The improved mold lock as claimed in claim 1, further including a safety device; the safety device comprising a housing having a cavity, and a resilient element positioned in the cavity.
3. The improved mold lock as claimed in claim 2 wherein the resilient element comprises a compression spring.
4. The improved mold lock as claimed in any one of claims 2 and 3 wherein said safety device is held in a compressed position by said bolt; and when said bolt is unlocked and moved away from said locking tumbler, said safety device is released to expand from the compressed position to an expanded position in

which expanded position said safety device blocks said locking tumbler whereby said locking tumbler and latch body are prevented from movement.

5. The improved mold lock as claimed in any one of claims 1 to 4 wherein the improved mold lock further includes an actuator attached to the latch body for moving the latch body and said tumbler between first and second positions.
6. The improved mold lock as claimed in claim 5 wherein the actuator is a hydraulic actuator;
7. The improved mold lock as claimed in claim 5 wherein the actuator is a pneumatic actuator.
8. The improved mold lock as claimed in claim 5 wherein the actuator is a magnetic actuator.
9. The improved mold lock as claimed in claim 5 wherein the actuator is a mechanical actuator.
10. The improved mold lock as claimed in claim 5 wherein the actuator is an electrical actuator.
11. The improved mold lock as claimed in any one of claims 1 to 10, wherein there are first and second locking tumblers attached to said latch body, and first and second bolts which are received by said first and second locking tumblers respectively, wherein said locking protrusions of the locking tumblers and said locking depressions of said bolts are configured such that upward or downward vertical movement of said latch body between the first and second positions simultaneously secures the first locking tumbler to the first bolt and releases the second locking tumbler from the second bolt.
12. The improved mold lock as claimed in claim 1 wherein the improved mold lock further includes a guide bar to which the latch body is slidably connected.

13. The improved mold lock as claimed in claim 12 wherein the guide bar is configured to move the latch body upwardly and downwardly.
14. The improved mold lock as claimed in any one of claims 2 to 10 wherein the improved mold lock further includes a guide bar to which the latch body is slidably connected.
15. The improved mold lock as claimed in any one of claims 2 to 10 wherein the improved mold lock further includes a guide bar slidably connected to the latch body for moving the latch body upwardly and downwardly;  
wherein when said safety device is released to expand from a compressed position to an expanded position in which expanded position said safety device blocks said locking tumbler whereby said locking tumbler and latch body is prevented from movement along the guide bar.
16. The improved mold lock as claimed in any one of claims 14 to 15 wherein there are first and second locking tumblers attached to said latch body, and first and second bolts which are received by said first and second locking tumblers respectively, wherein said locking protrusions of the locking tumblers and said locking depressions of said bolts are configured such that upward or downward vertical movement of said latch body between the first and second positions simultaneously secures the first locking tumbler to the first bolt and releases the second locking tumbler from the second bolt.
17. The improved mold lock as claimed in any one of claims 1 to 11 in combination with three or more mold plates.
18. The combination of lock and mold plates as claimed in claim 17, wherein said main latch body is upwardly and downwardly slidably connected to said second

center mold plate, and at least one said bolt is connected to each of said first side mold plate and third side mold plate.

19. The combination of lock and mold plates as claimed in claim 18, wherein the said mold plates open and close relative to each other in a pre-determined sequence.
20. The improved mold lock as claimed in any one of claims 12 to 16 in combination with three or more mold plates.
21. The combination of lock and mold plates as claimed in claim 20, wherein said main latch body is upwardly and downwardly slidably connected to said second center mold plate, and at least one said bolt is connected to either of said first side mold plate or third side mold plate.
22. The combination of lock and mold plates as claimed in claim 21, wherein the said mold plates open and close relative to each other in a pre-determined sequence.