# MORTISE LOCK CYLINDER

## Technical Field

**[0001]** The present invention relates generally to a door lock, and more particularly, the invention relates to a mortise lock cylinder for use with a mortise lock.

## Background Art

**[0002]** A mortise lock mechanism typically includes a case provided with a lock cylinder opening adjacent to a bolt. A lock cylinder assembly of similar cross-section is positioned in the lock cylinder opening. The lock cylinder assembly has a bolt-actuating device operated by the lock cylinder. The actuating device engages the bolt of the mortise lock mechanism to operate the bolt. In a configuration commonly referred to as a "profile" cylinder lock, for example, lock operating mechanisms are located at opposite sides of the door, with one of the lock operating mechanisms (e.g., exterior) being a keyed mechanism.

**[0003]** Difficulties have been experienced in attempting in adapting a single cylinder euro profile mortise lock to applications where the axial space is limited, such as a thin door application or where there is a desire to make the overall cylinder projection from the door face to be as low as possible. Earlier attempts to solve the problem require more cylinder space in the longitudinal direction since the tip of the key is used to rotate an interior clutch. By doing so, a significant amount of cylinder axial space needs to be cleared of any obstruction, which may become impractical if the cylinder projection becomes too long.

## Disclosure of Invention

**[0004]** The present invention, in one form thereof, is directed to a mortise lock cylinder. The mortise lock cylinder includes a turn-piece assembly including a turn-piece and a first clutch. The turn-piece is in driving engagement with the first clutch. The first clutch has a neutral position. A keyed cylinder assembly is configured to be operable by a key. The keyed cylinder assembly includes a second clutch and a plug body having a keyway. The plug body is in driving engagement with the second clutch. A housing is configured with a longitudinal cavity. The housing has a first end spaced apart from a second end. The longitudinal cavity extends along a longitudinal axis between the first end and the second end. A first portion of the turn-piece assembly is received in the first

end and a second portion of the keyed cylinder assembly is received in the second end. The housing has a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity. A cam is positioned in the cam slot and mounted for rotation about the longitudinal axis. The mortise lock cylinder is configured such that the cam always is drivably engaged with the first clutch, and configured such that the second clutch is drivably coupled to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

**[0005]** The present invention, in another form thereof, is directed to a mortise lock cylinder. The mortise lock cylinder includes a turn-piece assembly including a turn-piece and a first clutch. The turn-piece is in driving engagement with the first clutch. The first clutch has a neutral position longitudinally spaced from a non-neutral position. A keyed cylinder assembly is configured to be operable by a key. The keyed cylinder assembly includes a second clutch and a plug body having a keyway. The plug body is in driving engagement with the second clutch. A housing is configured with a longitudinal cavity. The housing has a first end spaced apart from a second end. The longitudinal cavity extends along a longitudinal axis between the first end and the second end. A first portion of the turn-piece assembly is received in the first end and a second portion of the keyed cylinder assembly is received in the second end. The housing has a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity. A cam is positioned in the cam slot. The mortise lock cylinder is configured such that the first clutch is rotationally fixed to the cam, and configured such that the second clutch drivably engages the first clutch when the key is inserted into the keyway of the plug body so that the cam is operable by the key.

**[0006]** The present invention, in another form thereof, is directed to a method for operating a mortise lock cylinder. The method includes: providing a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch; providing a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch; providing a housing for receiving a first portion of the turn-piece assembly and receiving a second portion of the keyed cylinder assembly, the housing having a central portion with a cam slot; providing a cam in the cam slot mounted to each of the first portion of the turn-piece assembly and the second portion of the keyed cylinder assembly; permanently drivably

engaging the cam with the first clutch such that the cam is always rotatable by the turn-piece; and drivably coupling the second clutch to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

**[0007]** As such, the present invention provides a design solution for a single cylinder euro profile mortise lock on a thin door application where axial space is limited or where there is a desire to make the overall cylinder projection from the door face to be as low as possible.

**[0008]** Other features and advantages will become apparent from the following description when viewed in accordance with the accompanying drawings and appended claims.

## Brief Description of Drawings

**[0009]** Fig. 1 is a perspective view of a mortise lock having an opening for receiving a mortise lock cylinder configured in accordance with an embodiment of the present invention.

**[0010]** Fig. 2 is a side view of the mortise lock cylinder of Fig. 1, with a portion broken away.

**[0011]** Fig. 3 is a cross-sectional view of the mortise lock cylinder of Figs. 1 and 2 taken along line 3-3 of Fig. 1.

**[0012]** Fig. 4 is a cross-sectional view of the mortise lock cylinder of Figs. 1 and 2 taken along line 4-4 of Fig. 1, showing a first clutch in a neutral position.

**[0013]** Fig. 5 is an exploded view of the mortise lock cylinder of Figs. 1-4.

**[0014]** Fig. 6A is an exploded view of the turn-piece assembly and the first clutch of the mortise lock cylinder of Figs. 1-5.

**[0015]** Fig. 6B is cross-sectional view of the assembled turn-piece assembly and first clutch of Fig. 6A (turn-piece removed) taken along plane 6B–6B.

**[0016]** Fig. 7 is an enlarged portion of the turn-piece assembly and first clutch of Fig. 6B, and further showing a second clutch.

**[0017]** Fig. 8 is an enlarged portion of the mortise lock cylinder of Fig. 4 with the first clutch in the neutral position.

**[0018]** Fig. 9 is an enlarged portion of the mortise lock cylinder of Fig. 4 similar to Fig. 8, but with the first clutch moved away from the neutral position by longitudinal engagement of the second clutch with the first clutch.

**[0019]** Fig. 10 is an enlarged portion of the mortise lock cylinder of Fig. 3 with the first clutch moved away from the neutral position as in Fig. 9 by the second clutch.

**[0020]** Fig. 11 is an enlarged portion of the assembled turn-piece assembly and first clutch of the cross-sectional view of Fig. 6B, and further showing the second clutch rotatably positioned to facilitate drivable engagement with the first clutch.

**[0021]** Fig. 12 is an enlarged portion of the mortise lock cylinder of Fig. 4 similar to Fig. 9, but with the second clutch drivably engaged with the first clutch and with the first clutch returned to the neutral position.

**[0022]** Fig. 13 is an enlarged portion of the mortise lock cylinder of Fig. 3 similar to Fig. 10, but with the second clutch drivably engaged with the first clutch and with the first clutch returned to the neutral position as in Fig. 12.

**[0023]** Fig. 14 is an enlarged portion of the assembled turn-piece assembly and first clutch of the cross-sectional view of Fig. 6B, similar to Fig. 11, but with the second clutch drivably engaged with the first clutch.

**[0024]** Fig. 15A is an end view of the cam member of the cam assembly shown in Figs. 2 and 5.

**[0025]** Fig. 15B is a side view of the cam member of the cam assembly shown in Fig. 15A.

**[0026]** Fig. 15C is a cross-sectional view of the cam member taken along line 15C-15C of Fig. 15A.

**[0027]** Fig. 15D is a cross-sectional view of the cam member taken along line 15D-15D of Fig. 15B.

**[0028]** Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

## Mode(s) for Carrying Out the Invention

**[0029]** Referring to Fig. 1, there is shown a mortise lock 10 of a type well known in the art. Mortise lock 10 includes a mortise housing 12 having an opening 14. Mortise housing 12 contains a latch bolt 16 and contains an internal locking mechanism (not shown) having a retractable deadbolt, e.g., bolt 18. Opening 14 is configured with a size and shape to receive a profile lock cylinder, such as a mortise lock cylinder 20 configured in accordance with an embodiment of the present invention. Mortise lock cylinder 20,

when installed in opening 14, is drivably coupled to the internal locking mechanism and in turn to bolt 18.

**[0030]** Referring now to Figs. 2-5, mortise lock cylinder 20 is shown in greater detail. Mortise lock cylinder 20 includes a mortise lock cylinder housing 22, a cam (e.g., a cam assembly) 24, a turn-piece assembly 26 and a keyed cylinder assembly 28. Cam 24 is coupled for rotatable operation with turn-piece assembly 26 and may be selectively coupled for rotatable operation with keyed cylinder assembly 28. Thus, cam 24 is configured to operate bolt 18 by actuation of one of turn-piece assembly 26 and keyed cylinder assembly 28.

**[0031]** Referring to Fig. 5, mortise lock cylinder housing 22 has a first end 30 spaced apart from a second end 32 along a longitudinal axis 34. A longitudinal cavity 36 extends along longitudinal axis 34 between first end 30 and second end 32, each of which being configured to receive a respective portion of turn-piece assembly 26 and keyed cylinder assembly 28. Longitudinal axis 34 defines a co-axis of rotation for turn-piece assembly 26 and keyed cylinder assembly 28, and thus for clarity and convenience longitudinal axis 34 may sometimes be referred to as co-axis of rotation 34. Located in a central portion 38 of mortise lock cylinder housing 22 is a cam slot 40 that radially extends perpendicular to the longitudinal extent of each of co-axis of rotation 34 and longitudinal cavity 36. Cam slot 40 is configured to receive cam 24.

**[0032]** Referring also to Figs. 6A and 6B, turn-piece assembly 26 includes a turn-piece 42, a retainer housing 44, a shaft 46, a set screw 48, a detent ball 50, a detent spring 52, a compression spring 54, a first clutch 56, and a pin 58.

**[0033]** Shaft 46 includes a proximal end 60 and a distal end 62. A stub portion 64 extends distally from proximal end 60 and a cylindrical portion 66 extends proximally from distal end 62. An annular shoulder 68 is located at the junction of stub portion 64 and cylindrical portion 66. Stub portion 64 is configured to be received in a corresponding opening in turn-piece 42 of like cross sectional shape and dimension. A raised annular feature 69 is located at distal end 62 of shaft 46.

**[0034]** Cylindrical portion 66 is configured to be received in longitudinal cavity 36 at first end 30 of mortise lock cylinder housing 22. Retainer housing 44 is configured to be positioned over stub portion 64 and in longitudinal contact with annular shoulder 68 to retain cylindrical portion 66 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of turn-piece assembly 26 along longitudinal axis 34. Retainer housing 44 is fixed to mortise lock cylinder housing 22 using conventional attachment

techniques, such as for example, by friction engagement, staking, welding, etc. Turn-piece 42 is longitudinally fixed to stub portion 64 by setscrew 48.

**[0035]** As used herein, the term "fixed" or variations thereof means a coupling of components that prevents a relative movement between the components. Also, the term "fixed" may be used in describing a conditional fixing and/or temporary fixing, as will be understood in the context that the term is used. For example, a component may be fixed to another component as to rotational movement, i.e., rotationally fixed, and yet the components may be able to move relative to one another longitudinally by some limited amount, i.e., the components are not longitudinally fixed within the limited range of longitudinal movement.

**[0036]** Cylindrical portion 66 has a hollow interior 70 extending proximally from distal end 62 and terminates to form an internal end wall 72. Cylindrical portion 66 includes a pair of diametrically opposed slots 74 located at distal end 62. Cylindrical portion 66 has a diametrically extending through-hole 76 that intersects hollow interior 70 between distal end 62 and internal end wall 72.

**[0037]** Referring also to Figs. 7-14, first clutch 56 includes a cylindrical shaft portion 78 configured to be slidably received in hollow interior 70 of cylindrical portion 66 of shaft 46 along longitudinal axis 34. As best shown in Fig. 6A, first clutch 56 has a first end 80, a first end portion 82, a second end 84 and a second end portion 86. First end portion 82 includes a diametrically extending through-slot 88 axially offset along longitudinal axis 34 from first end 80. Second end portion 86 includes a pair of diametrically opposed tabs 90. Second end portion 86 further includes a slot feature 92 in the form of a pair of diametrically opposed slots 92. In the present embodiment, the diametrically opposed slots 92 are rotationally offset, e.g., by 90 degrees, from the diametrically opposed tabs 90 at second end portion 86 of first clutch 56. First clutch 56 has a hollow interior 94 extending proximally from second end portion 86 and terminates to form an internal end wall 96.

**[0038]** Turn-piece assembly 26 is assembled as follows. Compression spring 54 is inserted into hollow interior 70 of cylindrical portion 66 of shaft 46. Cylindrical shaft portion 78 of first clutch 56 is then inserted into hollow interior 70 of cylindrical portion 66 of shaft 46, with compression spring 54 interposed between internal end wall 72 of cylindrical portion 66 of shaft 46 and first end 80 of first clutch 56. Thus, first clutch 56 is spring biased in a direction 95 toward keyed cylinder assembly 28 by compression spring 54.

**[0039]** As best shown in Figs. 3, 6B and 7, with compression spring 54 somewhat compressed and with the diametrically opposed tabs 90 of first clutch 56 temporarily slidably receivable by the diametrically opposed slots 74 of shaft 46 to accommodate assembly, through-slot 88 of first clutch 56 is diametrically aligned with through-hole 76 of shaft 46 and pin 58 is inserted through through-hole 76 and through-slot 88 with pin 58 forming a friction fit with the opposing ends of through-hole 76 of shaft 46. Accordingly, first clutch 56 is rotationally fixed with respect to shaft 46 of turn-piece assembly 26 relative to longitudinal axis 34, but first clutch 56 can slide in the longitudinal direction along longitudinal axis 34 within a certain range defined by the longitudinal extent of through-slot 88, i.e., the range being controlled by pin 58 and the slot feature of through-slot 88.

**[0040]** The turn-piece assembly 26 is now assembled at a stage ready for mounting to mortise lock cylinder housing 22. Referring again to Figs. 5-10, cylindrical portion 66 of shaft 46, to which first clutch 56 is mounted, is longitudinally inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at first end 30 along longitudinal axis 34. Retainer housing 44 is positioned over stub portion 64 of shaft 46 and in contact with annular shoulder 68. Retainer housing 44 is received over mortise lock cylinder housing 22 and is attached to mortise lock cylinder housing 22 using convention attachment techniques, e.g., by friction engagement, staking, welding, etc., to retain cylindrical portion 66 in longitudinal cavity 36. Turn-piece 42 is inserted onto stub portion 64, and is held in position relative to stub portion 64 by the tightening of setscrew 48 to engage a dimple recess in a side surface of stub portion 64. Accordingly, with turn-piece assembly 26, turn-piece 42 is provided in driving engagement with first clutch 56 in a permanent rotationally fixed coupling.

**[0041]** Referring to Figs. 5, 9, 10, 12 and 13, keyed cylinder assembly 28 includes a keyed cylinder plug 100, a retainer housing 102, a second clutch 104 and a compression spring 106.

**[0042]** Keyed cylinder plug 100 has internal operational characteristics well known in the art, and may be configured as a rekeyable lock cylinder. For ease of discussion, a description of the internal components and/or rekeying aspects of keyed cylinder plug 100 will not be discussed herein in detail.

**[0043]** As best shown in Figs. 5, 9, 10, 12 and 13, keyed cylinder plug 100 includes a plug body 108 having a plug face end 110 and a drive end portion 112. A keyway 114 configured to receive a key 116 extends longitudinally from plug face end 110 toward

drive end portion 112. Drive end portion 112 includes a hollow interior 118 and a pair of diametrically opposed slots 120. A raised annular feature 121 is located at drive end portion 112 of keyed cylinder plug 100. Plug body 108 is configured to be longitudinally inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at second end 32. Retainer housing 102 is configured to retain plug body 108 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of plug body 108 along longitudinal axis 34.

**[0044]** Referring to Figs. 4, 9, and 12, keyed cylinder plug 100 further includes a spring biased locking bar 122 which retractably engages a longitudinal locking bar notch 124 formed in a side wall 126 of longitudinal cavity 36 of mortise lock cylinder housing 22. If no key, or an improper key (not shown), is inserted into keyway 114, internal components (e.g., pins and racks) of keyed cylinder plug 100 are positioned to prevent locking bar 122 from being retracted out of the longitudinal locking bar notch 124 formed in side wall 126 of longitudinal cavity 36 of mortise lock cylinder housing 22, thereby maintaining a locked condition and preventing rotation of keyed cylinder plug 100 by the key about longitudinal axis 34. When a proper key 116 is inserted into keyway 114, the internal components (e.g., pins and racks) of keyed cylinder plug 100 are positioned such that locking bar 122 may be radially retracted into plug body 108 as keyed cylinder plug 100 is rotated by key 116, thereby establishing an unlocked condition, and permitting rotation of keyed cylinder plug 100 and locking bar 122 in longitudinal cavity 36 of mortise lock cylinder housing 22 about the longitudinal axis 34.

**[0045]** Referring to Figs. 5 and 7-14, second clutch 104 has a first end 128 and a second end 130. First end 128 includes a pair of diametrically opposed tabs 132 configured to be slidably received by the diametrically opposed slots 120 located at drive end portion 112 of plug body 108 of keyed cylinder plug 100. First end 128 of second clutch 104 further includes a longitudinal extension 133 that extends toward keyed cylinder plug 100 in direction 95. Second clutch 104 has a hollow interior 134 that extends from second end 130 toward first end 128 and terminates to form an interior end wall 136. Located at second end 130 is a protruded feature 138 in the form of a pair of diametrically opposed protrusions 138. Protruded feature 138 is configured to extend toward first clutch 56. Hollow interior 134 of second clutch 104 is configured to receive compression spring 106.

**[0046]** Keyed cylinder plug 100 is assembled as follows. First end 128 of second clutch 104 is inserted into hollow interior 118 of drive end portion 112 of plug body 108,

such that the diametrically opposed tabs 132 are slidably received by the diametrically opposed slots 120 located at drive end portion 112 of plug body 108 of keyed cylinder plug 100. Compression spring 106 is inserted into hollow interior 134 of second clutch 104.

**[0047]** The keyed cylinder assembly 28 is now assembled and ready for mounting to mortise lock cylinder housing 22. Plug body 108 of keyed cylinder plug 100 is then inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at second end 32, with compression spring 106 being interposed between interior end wall 136 of second clutch 104 and internal end wall 96 of first clutch 56. Retainer housing 102 is received over mortise lock cylinder housing 22 and is attached to mortise lock cylinder housing 22, e.g., by friction fit, staking, welding, etc., to retain plug body 108 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of keyed cylinder plug 100 of keyed cylinder assembly 28 along longitudinal axis 34. Thus, with keyed cylinder plug 100, plug body 108 is provided in driving engagement with second clutch 104, and the biasing force of compression spring 106 is exerted against second clutch 104 in direction 95.

**[0048]** Once turn-piece assembly 26, keyed cylinder assembly 28, and cam assembly 24 are mounted to mortise lock cylinder housing 22, cam assembly 24 is always rotationally fixed to turn-piece assembly 26, but is not rotationally fixed to keyed cylinder assembly 28.

**[0049]** Referring also to Figs. 15A-15D, cam assembly 24 includes a cam member 140 that is diametrically split into a first cam portion 142 and a second cam portion 144. First cam portion 142 is configured as a first half-round portion 146 from which diametrically extends a cam side wall 148 having an extension tab 150. Second cam portion 144 is configured as a second half-round portion 152 from which extends a cam side wall 154 having a cantilevered top portion 156. The cantilevered top portion 156 has a lower surface 158 with a slot 160 configured to receive the extension tab 150 of first cam portion 142.

**[0050]** Cam member 140 has two annular retention slots 162, 164 that are spaced longitudinally, and at least one drive slot 166, e.g., a pair of diametrically opposed drive slots 166, that extend longitudinally between the two annular retention slots 162, 164. The diametrically opposed drive slots 166 are configured to drivably receive a driving portion 90 of first clutch 56, regardless of whether first clutch 56 is in a neutral position 98 (see, e.g., Figs. 3, 4, 8, and 12), as determined by compression spring 54 and the

longitudinal extent of through-slot 88, or the first clutch 56 is longitudinally displaced from the neutral position. As such, the diametrically opposed tabs 90 of first clutch 56 always are positioned to drivably engage the diametrically opposed drive slots 166 of cam member 140, i.e., first clutch 56 always is rotationally fixed to cam assembly 24, and thus a rotation of first clutch 56 always will result in a rotation of cam assembly 24 around longitudinal axis 34. At this time, the diametrically opposed tabs 132 of second clutch 104 are positioned within annular retention slot 164 of cam member 140 and the protruded feature 138 of second clutch 104 is not drivably engaged with the slot feature 92 of first clutch 56, i.e., second clutch 104 is not rotationally fixed to first clutch 56 nor to cam assembly 24. In the present embodiment, second clutch 104 does not directly drivably engage cam assembly 24. Rather, second clutch 104 may be selectively coupled to first cam 56 to effect a driving of cam assembly 24 by keyed cylinder assembly 28.

**[0051]** Cam assembly 24 is assembled as follows. Turn-piece assembly 26 and a keyed cylinder assembly 28 have been previously mounted to mortise lock cylinder housing 22. Extension tab 150 of first cam portion 142 is inserted into slot 160 of second cam portion 144, with first half-round portion 146 brought into engagement with second half-round portion 152. At this time, annular retention slot 162 of cam member 140 engages the corresponding annular feature 69 at distal end 62 of shaft 46 of turn-piece assembly 26, and annular retention slot 164 of cam member 140 engages a corresponding annular feature 121 at drive end portion 112 of keyed cylinder plug 100. A retainer clip 168 then is slipped annularly over external surfaces of first half-round portion 146 and second half-round portion 152 to join the first cam portion 142 and second cam portion 144 to form the cam assembly 24.

**[0052]** Since turn-piece 42 is rotationally fixed to shaft 46, which in turn is rotationally fixed to first clutch 56, which in turn is rotationally fixed to cam assembly 24, the action of manually turning the turn-piece 42 always will rotate cam assembly 24 about co-axis of rotation 34 and consequently retract or throw the bolt 18 on the mortise lock 10.

**[0053]** Thus, with the present invention, there are two clutches, first clutch 56 and second clutch 104, which serve to drivably rotate cam assembly 24. While first clutch 56 is rotationally fixed with respect to shaft 46, first clutch 56 can slide in the longitudinal directions within the range which is controlled by pin 58 and through-slot 88. First clutch 56 is spring biased in direction 95 toward the exterior keyed cylinder plug 100 by compression spring 54. Second clutch 104 is placed axially between first clutch 56 and

the exterior keyed cylinder plug 100, and is always biased in direction 95 toward exterior keyed cylinder plug 100 by compression spring 106. Second clutch 104 is rotationally fixed with respect to plug body 108 of keyed cylinder plug 100, but second clutch 104 is normally biased by compression spring 106 out of engagement with first clutch 56 in which case second clutch 104 is free to rotate independent of cam assembly 24. The force of compression spring 106 is designed to be lower than that of compression spring 54 by a certain predetermined ratio to ensure proper operation.

**[0054]** As shown in Figs. 9-14, in the present embodiment when key 116 is inserted into the keyway 114 in keyed cylinder plug 100, the tip of key 116 will push against the extension 133 of second clutch 104 and in turn push second clutch 104 inward toward first clutch 56 in direction 170. When the protruded feature 138 of second clutch 104 is aligned with the slot feature 92 of first clutch 56 (see Figs. 12-14), the key 116 can be fully inserted, which will then longitudinally displace second clutch 104 to drivably engage the protruded feature 138 of second clutch 104 with the slot feature 92 of first clutch 56 and temporarily fix the rotation between first clutch 56 and second clutch 104 such that first clutch 56 and second clutch 104 rotate together, and with first clutch 56 being rotationally fixed to cam assembly 24. As such, second clutch 104 is temporarily rotationally coupled to cam assembly 24 via first clutch 56. Since the key 116 is fully inserted and is keyed to keyed cylinder plug 100, keyed cylinder plug 100 can now be rotated by rotation of key 116, which in turn rotates cam assembly 24 to retract or throw (i.e., extend) bolt 18 on mortise lock 10.

**[0055]** The turn-piece shaft 46 is spring loaded by compression spring 54 in order to allow the key 116 to be fully inserted even when the protruded feature 138 of second clutch 104 is not aligned with the slot feature 92 of first clutch 56 (see Figs. 9-11), i.e., thereby longitudinally displacing first clutch 56 in direction 170 away from keyed cylinder plug 100 and away from the neutral position 98 to a non-neutral position, such as when the turn-piece 42 is at an orientation other than in the vertical direction (position). This displacing of first clutch 56 in direction 170 is facilitated by the longitudinal extent of through-slot 88 and results in a compression of compression spring 54. Since the key 116 can be fully inserted, the keyed cylinder plug 100 can be rotated and eventually the protruded feature 138 of second clutch 104 will self-align with the slot feature 92 of first clutch 56, and once aligned, the protruded feature 138 of second clutch 104 will engage slot feature 92 of first clutch 56 in the axial direction 95 along longitudinal axis 34 by the

decompression of compression spring 54, thus returning first clutch 56 to the neutral position 98 illustrated in Figs. 12 and 13.

**[0056]** When the key 116 is axially retracted from keyed cylinder plug 100 in direction 95, second clutch 104 will disengage from first clutch 56 by action of the biasing force exerted by compression spring 106 in direction 95. Now first clutch 56 can rotate independently of keyed cylinder plug 100, so the turn-piece 42 can be turned to activate mortise lock 10, even though keyed cylinder plug 100 remains in a locked condition until the key is reinserted.

**[0057]** While this invention has been described with respect to at least one embodiment, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

## Claims

What is claimed is:

1. A mortise lock cylinder, characterized by:

a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch, the first clutch having a neutral position;

a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

a housing configured with a longitudinal cavity, the housing having a first end spaced apart from a second end, the longitudinal cavity extending along a longitudinal axis between the first end and the second end, a first portion of the turn-piece assembly being received in the first end and a second portion of the keyed cylinder assembly being received in the second end, the housing having a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity; and

a cam positioned in the cam slot and mounted for rotation about the longitudinal axis,

the mortise lock cylinder being configured such that the cam always is drivably engaged with the first clutch, and configured such that the second clutch is drivably coupled to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

2. The mortise lock cylinder of claim 1, characterized in that the second clutch is configured to drivably engage the first clutch to effect rotation of the cam by the second clutch.

3. The mortise lock cylinder of claim 2, characterized by:

the turn-piece assembly having a cylindrical portion having an end wall;

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch;

a first compression spring positioned between the first clutch and the end wall of the cylindrical portion of the turn-piece assembly, the first compression spring biasing the first clutch toward the second clutch to the neutral position;

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the second compression spring in a direction away from the first clutch,

wherein the second clutch is configured to longitudinally displace the first clutch from the neutral position to compress the first compression spring when the key is inserted into the keyway of the plug body if the protruded feature of the second clutch is not rotationally aligned with the slot feature of the first clutch, and configured such that when the key is rotated and the protruded feature of the second clutch is rotationally aligned with the slot feature of the first clutch, the first clutch is biased by the first compression spring to return to the neutral position such that the second clutch is drivably engaged with the first clutch.

4. The mortise lock cylinder of claim 1, characterized in that the second clutch is configured to longitudinally displace the first clutch from the neutral position if the second clutch is not aligned with the first clutch when the key is inserted into the keyway of the plug body.

5. The mortise lock cylinder of claim 4, characterized by the first clutch and second clutch being configured such that the second clutch drivably engages the first clutch for rotation about the longitudinal axis by a returning of the first clutch to the neutral position when the second clutch is aligned with the first clutch.

6. The mortise lock cylinder of claim 1, characterized by the turn-piece assembly including a shaft, the shaft including a stub portion and a cylindrical portion, the stub portion being configured to be attached to the turn-piece, and the cylindrical portion being configured to be mounted to the first clutch such that the first clutch is rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a predefined range of longitudinal movement.

7. The mortise lock cylinder of claim 6, characterized by:

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from the first clutch.

8. The mortise lock cylinder of claim 1, characterized by:

the turn-piece assembly including a shaft, the shaft including a stub portion having a proximal end and a cylindrical portion with a distal end, the stub portion being configured to be exterior to the housing and to which the turn-piece is fixed, and the cylindrical portion being configured to be received in the longitudinal cavity at first end, the cylinder portion having a first hollow interior that extends proximally from the distal end and terminates at a first internal end wall, the cylindrical portion having a diametrically extending through-hole that intersects the hollow interior between distal end and the internal end wall; and

the first clutch including a cylindrical shaft portion configured to be slidably received in the first hollow interior of cylindrical portion of the shaft, the first clutch having a first end portion with a diametrically extending through-slot and a second end portion, the second end portion having a first tab feature configured to drivably engage the cam to rotate about the longitudinal axis;

a first compression spring interposed between the first internal end wall of the cylindrical portion of the shaft and the first end portion of the first clutch; and

a pin inserted through the through-hole of the cylindrical portion of the shaft and through the through-slot of the first end portion of the first clutch, the pin forming a friction fit with the opposing ends of the through-hole of the shaft, the clutch being rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a range defined by a longitudinal extent of the through-slot.

9. The mortise lock cylinder of claim 8, characterized by:

the second end portion of the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from

the first clutch to bias the protruded feature of the second clutch out of engagement with the slot feature of the first clutch.

10. The mortise lock cylinder of claim 9, characterized in that the first compression spring and the second compression spring are configured such that a force generated by the second compression spring is lower than the force generated by the first compression spring.

11. A mortise lock cylinder, characterized by:

a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch, the first clutch having a neutral position longitudinally spaced from a non-neutral position;

a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

a housing configured with a longitudinal cavity, the housing having a first end spaced apart from a second end, the longitudinal cavity extending along a longitudinal axis between the first end and the second end, a first portion of the turn-piece assembly being reviewed in the first end and a second portion of the keyed cylinder assembly being reviewed in the second end, the housing having a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity; and

a cam positioned in the cam slot,

the mortise lock cylinder being configured such that the first clutch is rotationally fixed to the cam, and configured such that the second clutch drivably engages the first clutch when the key is inserted into the keyway of the plug body so that the cam is operable by the key.

12. The mortise lock cylinder of claim 11, characterized by the first clutch and second clutch being configured such that when the key is removed from the keyway the first clutch remains drivably engaged with the cam.

13. The mortise lock cylinder of claim 11, characterized by the turn-piece assembly including a shaft, the shaft including a stub portion and a cylindrical portion, the

stub portion being configured to be attached to the turn-piece, and the cylindrical portion being configured to be mounted to the first clutch such that the first clutch is rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed with respect to the shaft within a predefined range of longitudinal movement.

14. The mortise lock cylinder of claim 13, characterized by:

the cylindrical portion having an end wall;

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch;

a first compression spring positioned between the first clutch and the end wall of the cylindrical portion of the turn-piece assembly, the first compression spring biasing the first clutch toward the second clutch to the neutral position;

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the second compression spring in a direction away from the first clutch,

wherein second clutch is configured to longitudinally displace the first clutch from the neutral position to compress the first compression spring when the key is inserted into the keyway of the plug body if the protruded feature of the second clutch is not rotationally aligned with the slot feature of the first clutch, and configured such that when the key is rotated and the protruded feature of the second clutch is rotationally aligned with the slot feature of the first clutch, the first clutch is biased by the first compression spring to return to the neutral position such that the second clutch is drivably engaged with the first clutch.

15. The mortise lock cylinder of claim 11, characterized by:

the turn-piece assembly including a shaft, the shaft including a stub portion having a proximal end and a cylindrical portion with a distal end, the stub portion being configured to be exterior to the housing and to which the turn-piece is fixed, and the cylindrical portion being configured to be received in the longitudinal cavity at first end, the cylinder portion having a first hollow interior that extends proximally from the distal end and terminates at a first internal end wall, the cylindrical portion having a diametrically extending through-hole that intersects the hollow interior between distal end and the internal end wall; and

the first clutch including a cylindrical shaft portion configured to be slidably received in the first hollow interior of cylindrical portion of the shaft, the first clutch having a first end portion with a diametrically extending through-slot and a second end portion, the second end portion having a first tab feature configured to drivably engage the cam to rotate about the longitudinal axis;

a first compression spring interposed between the first internal end wall of the cylindrical portion of the shaft and the first end portion of the first clutch; and

a pin inserted through the through-hole of the cylindrical portion of the shaft and through the through-slot of the first end portion of the first clutch, the pin forming a friction fit with the opposing ends of the through-hole of the shaft, the clutch being rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a range defined by a longitudinal extent of the through-slot.

16. The mortise lock cylinder of claim 15, characterized by:

the second end portion of the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from the first clutch.

17. The mortise lock cylinder of claim 16, characterized in that the first compression spring and the second compression spring are configured such that a force generated by the second compression spring is lower than the force generated by the first compression spring.

18. A method for operating a mortise lock cylinder, characterized by:

providing a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch;

providing a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

providing a housing for receiving a first portion of the turn-piece assembly and receiving a second portion of the keyed cylinder assembly, the housing having a central portion with a cam slot;

providing a cam in the cam slot mounted to each of the first portion of the turn-piece assembly and the second portion of the keyed cylinder assembly;

permanently drivably engaging the cam with the first clutch such that the cam is always rotatable by the turn-piece; and

drivably coupling the second clutch to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

19. The method of claim 18, characterized by drivably engaging the first clutch with the second clutch to effect rotation of the cam by the second clutch.

20. The method of claim 19, characterized by:

longitudinally displacing the first clutch when the key is inserted into the keyway of the plug body if a protruded feature of the second clutch is not rotationally aligned with a slot feature of the first clutch; and

rotating the key to rotationally align the protruded feature of the second clutch with the slot feature of the first clutch such that the second clutch drivably engages the first clutch.

# MORTISE LOCK CYLINDER

## Technical Field

[0001] The present invention relates generally to a door lock, and more particularly, the invention relates to a mortise lock cylinder for use with a mortise lock.

## Background Art

[0002] A mortise lock mechanism typically includes a case provided with a lock cylinder opening adjacent to a bolt. A lock cylinder assembly of similar cross-section is positioned in the lock cylinder opening. The lock cylinder assembly has a bolt-actuating device operated by the lock cylinder. The actuating device engages the bolt of the mortise lock mechanism to operate the bolt. In a configuration commonly referred to as a "profile" cylinder lock, for example, lock operating mechanisms are located at opposite sides of the door, with one of the lock operating mechanisms (e.g., exterior) being a keyed mechanism.

[0003] Difficulties have been experienced in attempting in adapting a single cylinder euro profile mortise lock to applications where the axial space is limited, such as a thin door application or where there is a desire to make the overall cylinder projection from the door face to be as low as possible. Earlier attempts to solve the problem require more cylinder space in the longitudinal direction since the tip of the key is used to rotate an interior clutch. By doing so, a significant amount of cylinder axial space needs to be cleared of any obstruction, which may become impractical if the cylinder projection becomes too long.

## Disclosure of Invention

[0004] The present invention, in one form thereof, is directed to a mortise lock cylinder. The mortise lock cylinder includes a turn-piece assembly including a turn-piece and a first clutch. The turn-piece is in driving engagement with the first clutch. The first clutch has a neutral position. A keyed cylinder assembly is configured to be operable by a key. The keyed cylinder assembly includes a second clutch and a plug body having a keyway. The plug body is in driving engagement with the second clutch. A housing is configured with a longitudinal cavity. The housing has a first end spaced apart from a second end. The longitudinal cavity extends along a longitudinal axis between the first end and the second end. A first portion of the turn-piece assembly is received in the first

end and a second portion of the keyed cylinder assembly is received in the second end. The housing has a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity. A cam is positioned in the cam slot and mounted for rotation about the longitudinal axis. The mortise lock cylinder is configured such that the cam always is drivably engaged with the first clutch, and configured such that the second clutch is drivably coupled to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

**[0005]** The present invention, in another form thereof, is directed to a mortise lock cylinder. The mortise lock cylinder includes a turn-piece assembly including a turn-piece and a first clutch. The turn-piece is in driving engagement with the first clutch. The first clutch has a neutral position longitudinally spaced from a non-neutral position. A keyed cylinder assembly is configured to be operable by a key. The keyed cylinder assembly includes a second clutch and a plug body having a keyway. The plug body is in driving engagement with the second clutch. A housing is configured with a longitudinal cavity. The housing has a first end spaced apart from a second end. The longitudinal cavity extends along a longitudinal axis between the first end and the second end. A first portion of the turn-piece assembly is received in the first end and a second portion of the keyed cylinder assembly is received in the second end. The housing has a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity. A cam is positioned in the cam slot. The mortise lock cylinder is configured such that the first clutch is rotationally fixed to the cam, and configured such that the second clutch drivably engages the first clutch when the key is inserted into the keyway of the plug body so that the cam is operable by the key.

**[0006]** The present invention, in another form thereof, is directed to a method for operating a mortise lock cylinder. The method includes: providing a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch; providing a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch; providing a housing for receiving a first portion of the turn-piece assembly and receiving a second portion of the keyed cylinder assembly, the housing having a central portion with a cam slot; providing a cam in the cam slot mounted to each of the first portion of the turn-piece assembly and the second portion of the keyed cylinder assembly; permanently drivably

engaging the cam with the first clutch such that the cam is always rotatable by the turn-piece; and drivably coupling the second clutch to the cam via the first clutch when the key is inserted into the keyed cylinder assembly.

**[0007]** As such, the present invention provides a design solution for a single cylinder euro profile mortise lock on a thin door application where axial space is limited or where there is a desire to make the overall cylinder projection from the door face to be as low as possible.

**[0008]** Other features and advantages will become apparent from the following description when viewed in accordance with the accompanying drawings and appended claims.

## Brief Description of Drawings

**[0009]** Fig. 1 is a perspective view of a mortise lock having an opening for receiving a mortise lock cylinder configured in accordance with an embodiment of the present invention.

**[0010]** Fig. 2 is a side view of the mortise lock cylinder of Fig. 1, with a portion broken away.

**[0011]** Fig. 3 is a cross-sectional view of the mortise lock cylinder of Figs. 1 and 2 taken along line 3-3 of Fig. 1.

**[0012]** Fig. 4 is a cross-sectional view of the mortise lock cylinder of Figs. 1 and 2 taken along line 4-4 of Fig. 1, showing a first clutch in a neutral position.

**[0013]** Fig. 5 is an exploded view of the mortise lock cylinder of Figs. 1-4.

**[0014]** Fig. 6A is an exploded view of the turn-piece assembly and the first clutch of the mortise lock cylinder of Figs. 1-5.

**[0015]** Fig. 6B is cross-sectional view of the assembled turn-piece assembly and first clutch of Fig. 6A (turn-piece removed) taken along plane 6B–6B.

**[0016]** Fig. 7 is an enlarged portion of the turn-piece assembly and first clutch of Fig. 6B, and further showing a second clutch.

**[0017]** Fig. 8 is an enlarged portion of the mortise lock cylinder of Fig. 4 with the first clutch in the neutral position.

**[0018]** Fig. 9 is an enlarged portion of the mortise lock cylinder of Fig. 4 similar to Fig. 8, but with the first clutch moved away from the neutral position by longitudinal engagement of the second clutch with the first clutch.

**[0019]** Fig. 10 is an enlarged portion of the mortise lock cylinder of Fig. 3 with the first clutch moved away from the neutral position as in Fig. 9 by the second clutch.

**[0020]** Fig. 11 is an enlarged portion of the assembled turn-piece assembly and first clutch of the cross-sectional view of Fig. 6B, and further showing the second clutch rotatably positioned to facilitate drivable engagement with the first clutch.

**[0021]** Fig. 12 is an enlarged portion of the mortise lock cylinder of Fig. 4 similar to Fig. 9, but with the second clutch drivably engaged with the first clutch and with the first clutch returned to the neutral position.

**[0022]** Fig. 13 is an enlarged portion of the mortise lock cylinder of Fig. 3 similar to Fig. 10, but with the second clutch drivably engaged with the first clutch and with the first clutch returned to the neutral position as in Fig. 12.

**[0023]** Fig. 14 is an enlarged portion of the assembled turn-piece assembly and first clutch of the cross-sectional view of Fig. 6B, similar to Fig. 11, but with the second clutch drivably engaged with the first clutch.

**[0024]** Fig. 15A is an end view of the cam member of the cam assembly shown in Figs. 2 and 5.

**[0025]** Fig. 15B is a side view of the cam member of the cam assembly shown in Fig. 15A.

**[0026]** Fig. 15C is a cross-sectional view of the cam member taken along line 15C-15C of Fig. 15A.

**[0027]** Fig. 15D is a cross-sectional view of the cam member taken along line 15D-15D of Fig. 15B.

**[0028]** Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

## Mode(s) for Carrying Out the Invention

**[0029]** Referring to Fig. 1, there is shown a mortise lock 10 of a type well known in the art. Mortise lock 10 includes a mortise housing 12 having an opening 14. Mortise housing 12 contains a latch bolt 16 and contains an internal locking mechanism (not shown) having a retractable deadbolt, e.g., bolt 18. Opening 14 is configured with a size and shape to receive a profile lock cylinder, such as a mortise lock cylinder 20 configured in accordance with an embodiment of the present invention. Mortise lock cylinder 20,

when installed in opening 14, is drivably coupled to the internal locking mechanism and in turn to bolt 18.

**[0030]** Referring now to Figs. 2-5, mortise lock cylinder 20 is shown in greater detail. Mortise lock cylinder 20 includes a mortise lock cylinder housing 22, a cam (e.g., a cam assembly) 24, a turn-piece assembly 26 and a keyed cylinder assembly 28. Cam 24 is coupled for rotatable operation with turn-piece assembly 26 and may be selectively coupled for rotatable operation with keyed cylinder assembly 28. Thus, cam 24 is configured to operate bolt 18 by actuation of one of turn-piece assembly 26 and keyed cylinder assembly 28.

**[0031]** Referring to Fig. 5, mortise lock cylinder housing 22 has a first end 30 spaced apart from a second end 32 along a longitudinal axis 34. A longitudinal cavity 36 extends along longitudinal axis 34 between first end 30 and second end 32, each of which being configured to receive a respective portion of turn-piece assembly 26 and keyed cylinder assembly 28. Longitudinal axis 34 defines a co-axis of rotation for turn-piece assembly 26 and keyed cylinder assembly 28, and thus for clarity and convenience longitudinal axis 34 may sometimes be referred to as co-axis of rotation 34. Located in a central portion 38 of mortise lock cylinder housing 22 is a cam slot 40 that radially extends perpendicular to the longitudinal extent of each of co-axis of rotation 34 and longitudinal cavity 36. Cam slot 40 is configured to receive cam 24.

**[0032]** Referring also to Figs. 6A and 6B, turn-piece assembly 26 includes a turn-piece 42, a retainer housing 44, a shaft 46, a set screw 48, a detent ball 50, a detent spring 52, a compression spring 54, a first clutch 56, and a pin 58.

**[0033]** Shaft 46 includes a proximal end 60 and a distal end 62. A stub portion 64 extends distally from proximal end 60 and a cylindrical portion 66 extends proximally from distal end 62. An annular shoulder 68 is located at the junction of stub portion 64 and cylindrical portion 66. Stub portion 64 is configured to be received in a corresponding opening in turn-piece 42 of like cross-sectional shape and dimension. A raised annular feature 69 is located at distal end 62 of shaft 46.

**[0034]** Cylindrical portion 66 is configured to be received in longitudinal cavity 36 at first end 30 of mortise lock cylinder housing 22. Retainer housing 44 is configured to be positioned over stub portion 64 and in longitudinal contact with annular shoulder 68 to retain cylindrical portion 66 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of turn-piece assembly 26 along longitudinal axis 34. Retainer housing 44 is fixed to mortise lock cylinder housing 22 using conventional attachment

techniques, such as for example, by friction engagement, staking, welding, etc. Turn-piece 42 is longitudinally fixed to stub portion 64 by setscrew 48.

**[0035]** As used herein, the term "fixed" or variations thereof means a coupling of components that prevents a relative movement between the components. Also, the term "fixed" may be used in describing a conditional fixing and/or temporary fixing, as will be understood in the context that the term is used. For example, a component may be fixed to another component as to rotational movement, i.e., rotationally fixed, and yet the components may be able to move relative to one another longitudinally by some limited amount, i.e., the components are not longitudinally fixed within the limited range of longitudinal movement.

**[0036]** Cylindrical portion 66 has a hollow interior 70 extending proximally from distal end 62 and terminates to form an internal end wall 72. Cylindrical portion 66 includes a pair of diametrically opposed slots 74 located at distal end 62. Cylindrical portion 66 has a diametrically extending through-hole 76 that intersects hollow interior 70 between distal end 62 and internal end wall 72.

**[0037]** Referring also to Figs. 7-14, first clutch 56 includes a cylindrical shaft portion 78 configured to be slidably received in hollow interior 70 of cylindrical portion 66 of shaft 46 along longitudinal axis 34. As best shown in Fig. 6A, first clutch 56 has a first end 80, a first end portion 82, a second end 84 and a second end portion 86. First end portion 82 includes a diametrically extending through-slot 88 axially offset along longitudinal axis 34 from first end 80. Second end portion 86 includes a pair of diametrically opposed tabs 90. Second end portion 86 further includes a slot feature 92 in the form of a pair of diametrically opposed slots 92. In the present embodiment, the diametrically opposed slots 92 are rotationally offset, e.g., by 90 degrees, from the diametrically opposed tabs 90 at second end portion 86 of first clutch 56. First clutch 56 has a hollow interior 94 extending proximally from second end portion 86 and terminates to form an internal end wall 96.

**[0038]** Turn-piece assembly 26 is assembled as follows. Compression spring 54 is inserted into hollow interior 70 of cylindrical portion 66 of shaft 46. Cylindrical shaft portion 78 of first clutch 56 is then inserted into hollow interior 70 of cylindrical portion 66 of shaft 46, with compression spring 54 interposed between internal end wall 72 of cylindrical portion 66 of shaft 46 and first end 80 of first clutch 56. Thus, first clutch 56 is spring biased in a direction 95 toward keyed cylinder assembly 28 by compression spring 54.

**[0039]** As best shown in Figs. 3, 6B and 7, with compression spring 54 somewhat compressed and with the diametrically opposed tabs 90 of first clutch 56 temporarily slidably receivable by the diametrically opposed slots 74 of shaft 46 to accommodate assembly, through-slot 88 of first clutch 56 is diametrically aligned with through-hole 76 of shaft 46 and pin 58 is inserted through through-hole 76 and through-slot 88 with pin 58 forming a friction fit with the opposing ends of through-hole 76 of shaft 46. Accordingly, first clutch 56 is rotationally fixed with respect to shaft 46 of turn-piece assembly 26 relative to longitudinal axis 34, but first clutch 56 can slide in the longitudinal direction along longitudinal axis 34 within a certain range defined by the longitudinal extent of through-slot 88, i.e., the range being controlled by pin 58 and the slot feature of through-slot 88.

**[0040]** The turn-piece assembly 26 is now assembled at a stage ready for mounting to mortise lock cylinder housing 22. Referring again to Figs. 5-10, cylindrical portion 66 of shaft 46, to which first clutch 56 is mounted, is longitudinally inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at first end 30 along longitudinal axis 34. Retainer housing 44 is positioned over stub portion 64 of shaft 46 and in contact with annular shoulder 68. Retainer housing 44 is received over mortise lock cylinder housing 22 and is attached to mortise lock cylinder housing 22 using convention attachment techniques, e.g., by friction engagement, staking, welding, etc., to retain cylindrical portion 66 in longitudinal cavity 36. Turn-piece 42 is inserted onto stub portion 64, and is held in position relative to stub portion 64 by the tightening of setscrew 48 to engage a dimple recess in a side surface of stub portion 64. Accordingly, with turn-piece assembly 26, turn-piece 42 is provided in driving engagement with first clutch 56 in a permanent rotationally fixed coupling.

**[0041]** Referring to Figs. 5, 9, 10, 12 and 13, keyed cylinder assembly 28 includes a keyed cylinder plug 100, a retainer housing 102, a second clutch 104 and a compression spring 106.

**[0042]** Keyed cylinder plug 100 has internal operational characteristics well known in the art, and may be configured as a rekeyable lock cylinder. For ease of discussion, a description of the internal components and/or rekeying aspects of keyed cylinder plug 100 will not be discussed herein in detail.

**[0043]** As best shown in Figs. 5, 9, 10, 12 and 13, keyed cylinder plug 100 includes a plug body 108 having a plug face end 110 and a drive end portion 112. A keyway 114 configured to receive a key 116 extends longitudinally from plug face end 110 toward

drive end portion 112. Drive end portion 112 includes a hollow interior 118 and a pair of diametrically opposed slots 120. A raised annular feature 121 is located at drive end portion 112 of keyed cylinder plug 100. Plug body 108 is configured to be longitudinally inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at second end 32. Retainer housing 102 is configured to retain plug body 108 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of plug body 108 along longitudinal axis 34.

**[0044]** Referring to Figs. 4, 9, and 12, keyed cylinder plug 100 further includes a spring biased locking bar 122 which retractably engages a longitudinal locking bar notch 124 formed in a side wall 126 of longitudinal cavity 36 of mortise lock cylinder housing 22. If no key, or an improper key (not shown), is inserted into keyway 114, internal components (e.g., pins and racks) of keyed cylinder plug 100 are positioned to prevent locking bar 122 from being retracted out of the longitudinal locking bar notch 124 formed in side wall 126 of longitudinal cavity 36 of mortise lock cylinder housing 22, thereby maintaining a locked condition and preventing rotation of keyed cylinder plug 100 by the key about longitudinal axis 34. When a proper key 116 is inserted into keyway 114, the internal components (e.g., pins and racks) of keyed cylinder plug 100 are positioned such that locking bar 122 may be radially retracted into plug body 108 as keyed cylinder plug 100 is rotated by key 116, thereby establishing an unlocked condition, and permitting rotation of keyed cylinder plug 100 and locking bar 122 in longitudinal cavity 36 of mortise lock cylinder housing 22 about the longitudinal axis 34.

**[0045]** Referring to Figs. 5 and 7-14, second clutch 104 has a first end 128 and a second end 130. First end 128 includes a pair of diametrically opposed tabs 132 configured to be slidably received by the diametrically opposed slots 120 located at drive end portion 112 of plug body 108 of keyed cylinder plug 100. First end 128 of second clutch 104 further includes a longitudinal extension 133 that extends toward keyed cylinder plug 100 in direction 95. Second clutch 104 has a hollow interior 134 that extends from second end 130 toward first end 128 and terminates to form an interior end wall 136. Located at second end 130 is a protruded feature 138 in the form of a pair of diametrically opposed protrusions 138. Protruded feature 138 is configured to extend toward first clutch 56. Hollow interior 134 of second clutch 104 is configured to receive compression spring 106.

**[0046]** Keyed cylinder plug 100 is assembled as follows. First end 128 of second clutch 104 is inserted into hollow interior 118 of drive end portion 112 of plug body 108,

such that the diametrically opposed tabs 132 are slidably received by the diametrically opposed slots 120 located at drive end portion 112 of plug body 108 of keyed cylinder plug 100. Compression spring 106 is inserted into hollow interior 134 of second clutch 104.

**[0047]** The keyed cylinder assembly 28 is now assembled and ready for mounting to mortise lock cylinder housing 22. Plug body 108 of keyed cylinder plug 100 is then inserted into longitudinal cavity 36 of mortise lock cylinder housing 22 at second end 32, with compression spring 106 being interposed between interior end wall 136 of second clutch 104 and internal end wall 96 of first clutch 56. Retainer housing 102 is received over mortise lock cylinder housing 22 and is attached to mortise lock cylinder housing 22, e.g., by friction fit, staking, welding, etc., to retain plug body 108 in longitudinal cavity 36 of mortise lock cylinder housing 22 and restrain movement of keyed cylinder plug 100 of keyed cylinder assembly 28 along longitudinal axis 34. Thus, with keyed cylinder plug 100, plug body 108 is provided in driving engagement with second clutch 104, and the biasing force of compression spring 106 is exerted against second clutch 104 in direction 95.

**[0048]** Once turn-piece assembly 26, keyed cylinder assembly 28, and cam assembly 24 are mounted to mortise lock cylinder housing 22, cam assembly 24 is always rotationally fixed to turn-piece assembly 26, but is not rotationally fixed to keyed cylinder assembly 28.

**[0049]** Referring also to Figs. 15A-15D, cam assembly 24 includes a cam member 140 that is diametrically split into a first cam portion 142 and a second cam portion 144. First cam portion 142 is configured as a first half-round portion 146 from which diametrically extends a cam side wall 148 having an extension tab 150. Second cam portion 144 is configured as a second half-round portion 152 from which extends a cam side wall 154 having a cantilevered top portion 156. The cantilevered top portion 156 has a lower surface 158 with a slot 160 configured to receive the extension tab 150 of first cam portion 142.

**[0050]** Cam member 140 has two annular retention slots 162, 164 that are spaced longitudinally, and at least one drive slot 166, e.g., a pair of diametrically opposed drive slots 166, that extend longitudinally between the two annular retention slots 162, 164. The diametrically opposed drive slots 166 are configured to drivably receive a driving portion 90 of first clutch 56, regardless of whether first clutch 56 is in a neutral position 98 (see, e.g., Figs. 3, 4, 8, and 12), as determined by compression spring 54 and the

longitudinal extent of through-slot 88, or the first clutch 56 is longitudinally displaced from the neutral position. As such, the diametrically opposed tabs 90 of first clutch 56 always are positioned to drivably engage the diametrically opposed drive slots 166 of cam member 140, i.e., first clutch 56 always is rotationally fixed to cam assembly 24, and thus a rotation of first clutch 56 always will result in a rotation of cam assembly 24 around longitudinal axis 34. At this time, the diametrically opposed tabs 132 of second clutch 104 are positioned within annular retention slot 164 of cam member 140 and the protruded feature 138 of second clutch 104 is not drivably engaged with the slot feature 92 of first clutch 56, i.e., second clutch 104 is not rotationally fixed to first clutch 56 nor to cam assembly 24. In the present embodiment, second clutch 104 does not directly drivably engage cam assembly 24. Rather, second clutch 104 may be selectively coupled to first cam 56 to effect a driving of cam assembly 24 by keyed cylinder assembly 28.

**[0051]** Cam assembly 24 is assembled as follows. Turn-piece assembly 26 and a keyed cylinder assembly 28 have been previously mounted to mortise lock cylinder housing 22. Extension tab 150 of first cam portion 142 is inserted into slot 160 of second cam portion 144, with first half-round portion 146 brought into engagement with second half-round portion 152. At this time, annular retention slot 162 of cam member 140 engages the corresponding annular feature 69 at distal end 62 of shaft 46 of turn-piece assembly 26, and annular retention slot 164 of cam member 140 engages a corresponding annular feature 121 at drive end portion 112 of keyed cylinder plug 100. A retainer clip 168 then is slipped annularly over external surfaces of first half-round portion 146 and second half-round portion 152 to join the first cam portion 142 and second cam portion 144 to form the cam assembly 24.

**[0052]** Since turn-piece 42 is rotationally fixed to shaft 46, which in turn is rotationally fixed to first clutch 56, which in turn is rotationally fixed to cam assembly 24, the action of manually turning the turn-piece 42 always will rotate cam assembly 24 about co-axis of rotation 34 and consequently retract or throw the bolt 18 on the mortise lock 10.

**[0053]** Thus, with the present invention, there are two clutches, first clutch 56 and second clutch 104, which serve to drivably rotate cam assembly 24. While first clutch 56 is rotationally fixed with respect to shaft 46, first clutch 56 can slide in the longitudinal directions within the range which is controlled by pin 58 and through-slot 88. First clutch 56 is spring biased in direction 95 toward the exterior keyed cylinder plug 100 by compression spring 54. Second clutch 104 is placed axially between first clutch 56 and

the exterior keyed cylinder plug 100, and is always biased in direction 95 toward exterior keyed cylinder plug 100 by compression spring 106. Second clutch 104 is rotationally fixed with respect to plug body 108 of keyed cylinder plug 100, but second clutch 104 is normally biased by compression spring 106 out of engagement with first clutch 56 in which case second clutch 104 is free to rotate independent of cam assembly 24. The force of compression spring 106 is designed to be lower than that of compression spring 54 by a certain predetermined ratio to ensure proper operation.

**[0054]** As shown in Figs. 9-14, in the present embodiment when key 116 is inserted into the keyway 114 in keyed cylinder plug 100, the tip of key 116 will push against the extension 133 of second clutch 104 and in turn push second clutch 104 inward toward first clutch 56 in direction 170. When the protruded feature 138 of second clutch 104 is aligned with the slot feature 92 of first clutch 56 (see Figs. 12-14), the key 116 can be fully inserted, which will then longitudinally displace second clutch 104 to drivably engage the protruded feature 138 of second clutch 104 with the slot feature 92 of first clutch 56 and temporarily fix the rotation between first clutch 56 and second clutch 104 such that first clutch 56 and second clutch 104 rotate together, and with first clutch 56 being rotationally fixed to cam assembly 24. As such, second clutch 104 is temporarily rotationally coupled to cam assembly 24 via first clutch 56. Since the key 116 is fully inserted and is keyed to keyed cylinder plug 100, keyed cylinder plug 100 can now be rotated by rotation of key 116, which in turn rotates cam assembly 24 to retract or throw (i.e., extend) bolt 18 on mortise lock 10.

**[0055]** The turn-piece shaft 46 is spring loaded by compression spring 54 in order to allow the key 116 to be fully inserted even when the protruded feature 138 of second clutch 104 is not aligned with the slot feature 92 of first clutch 56 (see Figs. 9-11), i.e., thereby longitudinally displacing first clutch 56 in direction 170 away from keyed cylinder plug 100 and away from the neutral position 98 to a non-neutral position, such as when the turn-piece 42 is at an orientation other than in the vertical direction (position). This displacing of first clutch 56 in direction 170 is facilitated by the longitudinal extent of through-slot 88 and results in a compression of compression spring 54. Since the key 116 can be fully inserted, the keyed cylinder plug 100 can be rotated and eventually the protruded feature 138 of second clutch 104 will self-align with the slot feature 92 of first clutch 56, and once aligned, the protruded feature 138 of second clutch 104 will engage slot feature 92 of first clutch 56 in the axial direction 95 along longitudinal axis 34 by the

decompression of compression spring 54, thus returning first clutch 56 to the neutral position 98 illustrated in Figs. 12 and 13.

**[0056]** When the key 116 is axially retracted from keyed cylinder plug 100 in direction 95, second clutch 104 will disengage from first clutch 56 by action of the biasing force exerted by compression spring 106 in direction 95. Now first clutch 56 can rotate independently of keyed cylinder plug 100, so the turn-piece 42 can be turned to activate mortise lock 10, even though keyed cylinder plug 100 remains in a locked condition until the key is reinserted.

**[0057]** While this invention has been described with respect to at least one embodiment, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

Claims

1. A mortise lock cylinder, including:

a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch, the first clutch having a neutral position;

a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

a housing configured with a longitudinal cavity, the housing having a first end spaced apart from a second end, the longitudinal cavity extending along a longitudinal axis between the first end and the second end, a first portion of the turn-piece assembly being received in the first end and a second portion of the keyed cylinder assembly being received in the second end, the housing having a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity; and

a cam positioned in the cam slot and mounted for rotation about the longitudinal axis,

the mortise lock cylinder being configured such that the cam always is drivably engaged with the first clutch, and configured such that the second clutch is drivably coupled to the cam via the first clutch when the key is inserted into the keyed cylinder assembly and characterized in that the second clutch is configured to longitudinally displace the first clutch from the neutral position if the second clutch is not aligned with the first clutch when the key is inserted into the keyway of the plug body.

2. The mortise lock cylinder of claim 1, characterized in that the second clutch is configured to drivably engage the first clutch to effect rotation of the cam by the second clutch.

3. The mortise lock cylinder of claim 2, characterized by:

the turn-piece assembly having a cylindrical portion having an end wall;

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch;

a first compression spring positioned between the first clutch and the end wall of the cylindrical portion of the turn-piece assembly, the first compression spring biasing the first clutch toward the second clutch to the neutral position;

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the second compression spring in a direction away from the first clutch,

wherein the second clutch is configured to longitudinally displace the first clutch from the neutral position to compress the first compression spring when the key is inserted into the keyway of the plug body if the protruded feature of the second clutch is not rotationally aligned with the slot feature of the first clutch, and configured such that when the key is rotated and the protruded feature of the second clutch is rotationally aligned with the slot feature of the first clutch, the first clutch is biased by the first compression spring to return to the neutral position such that the second clutch is drivably engaged with the first clutch.

4. The mortise lock cylinder of claim 1, characterized by the first clutch and second clutch being configured such that the second clutch drivably engages the first clutch for rotation about the longitudinal axis by a returning of the first clutch to the neutral position when the second clutch is aligned with the first clutch.

5. The mortise lock cylinder of claim 1, characterized by the turn-piece assembly including a shaft, the shaft including a stub portion and a cylindrical portion, the stub portion being configured to be attached to the turn-piece, and the cylindrical portion being configured to be mounted to the first clutch such that the first clutch is rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a predefined range of longitudinal movement.

6. The mortise lock cylinder of claim 5, characterized by:

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from the first clutch.

7. The mortise lock cylinder of claim 1, characterized by:

the turn-piece assembly including a shaft, the shaft including a stub portion having a proximal end and a cylindrical portion with a distal end, the stub portion being configured to be exterior to the housing and to which the turn-piece is fixed, and the cylindrical portion being configured to be received in the longitudinal cavity at first end, the cylinder portion having a first hollow interior that extends proximally from the distal end and terminates at a first internal end wall, the cylindrical portion having a

diametrically extending through-hole that intersects the hollow interior between distal end and the internal end wall; and

the first clutch including a cylindrical shaft portion configured to be slidably received in the first hollow interior of cylindrical portion of the shaft, the first clutch having a first end portion with a diametrically extending through-slot and a second end portion, the second end portion having a first tab feature configured to drivably engage the cam to rotate about the longitudinal axis;

a first compression spring interposed between the first internal end wall of the cylindrical portion of the shaft and the first end portion of the first clutch; and

a pin inserted through the through-hole of the cylindrical portion of the shaft and through the through-slot of the first end portion of the first clutch, the pin forming a friction fit with the opposing ends of the through-hole of the shaft, the clutch being rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a range defined by a longitudinal extent of the through- slot.

8. The mortise lock cylinder of claim 7, characterized by:

the second end portion of the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from the first clutch to bias the protruted feature of the second clutch out of engagement with the slot feature of the first clutch.

9. The mortise lock cylinder of claim 8, characterized in that the first

compression spring and the second compression spring are configured such that a force generated by the second compression spring is lower than the force generated by the first compression spring.

10. A mortise lock cylinder, including:

a turn-piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch, the first clutch having a neutral position longitudinally spaced from a non-neutral position;

a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

a housing configured with a longitudinal cavity, the housing having a first end spaced apart from a second end, the longitudinal cavity extending along a longitudinal axis between the first end and the second end, a first portion of the turn-piece assembly being reviewed in the first end and a second portion of the keyed cylinder assembly being reviewed in the second end, the housing having a central portion with a cam slot formed in the housing that radially extends perpendicular to the longitudinal extent of the longitudinal cavity; and

a cam positioned in the cam slot,

the mortise lock cylinder being configured such that the first clutch is rotationally fixed to the cam, and configured such that the second clutch drivably engages the first clutch when the key is inserted into the keyway of the plug body so that the cam is operable by the key and characterized by the turn-piece assembly including a shaft, the

shaft including a stub portion and a cylindrical portion, the stub portion being configured to be attached to the turn-piece, and the cylindrical portion being configured to be mounted to the first clutch such that the first clutch is rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed with respect to the shaft within a predefined range of longitudinal movement.

11. The mortise lock cylinder of claim 10, characterized by the first clutch and second clutch being configured such that when the key is removed from the keyway the first clutch remains drivably engaged with the cam.

12. The mortise lock cylinder of claim 11, characterized by:

the cylindrical portion having an end wall;

the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch;

a first compression spring positioned between the first clutch and the end wall of the cylindrical portion of the turn-piece assembly, the first compression spring biasing the first clutch toward the second clutch to the neutral position;

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the second compression spring in a direction away from the first clutch,

wherein second clutch is configured to longitudinally displace the first clutch from the neutral position to compress the first compression spring when the key is inserted into the keyway of the plug body if the protruded feature of the second clutch is not rotationally aligned with the slot feature of the first clutch, and configured such that when the key is rotated and the protruded feature of the second clutch is rotationally aligned with the slot feature of the first clutch, the first clutch is biased by the first compression spring to return to the neutral position such that the second clutch is drivably engaged with the first clutch.

13. The mortise lock cylinder of claim 10, characterized by:

the turn-piece assembly including a shaft, the shaft including a stub portion having a proximal end and a cylindrical portion with a distal end, the stub portion being configured to be exterior to the housing and to which the turn-piece is fixed, and the cylindrical portion being configured to be received in the longitudinal cavity at first end, the cylinder portion having a first hollow interior that extends proximally from the distal end and terminates at a first internal end wall, the cylindrical portion having a

diametrically extending through-hole that intersects the hollow interior between distal end and the internal end wall; and

the first clutch including a cylindrical shaft portion configured to be slidably received in the first hollow interior of cylindrical portion of the shaft, the first clutch having a first end portion with a diametrically extending through-slot and a second end portion, the second end portion having a first tab feature configured to drivably engage the cam to rotate about the longitudinal axis;

a first compression spring interposed between the first internal end wall of the cylindrical portion of the shaft and the first end portion of the first clutch; and

a pin inserted through the through-hole of the cylindrical portion of the shaft and through the through-slot of the first end portion of the first clutch, the pin forming a friction fit with the opposing ends of the through-hole of the shaft, the clutch being rotationally fixed with respect to the shaft relative to the longitudinal axis, but not longitudinally fixed within a range defined by a longitudinal extent of the through- slot.

14. The mortise lock cylinder of claim 13, characterized by:

the second end portion of the first clutch having a slot feature;

the second clutch having a protruded feature configured to be selectively received by the slot feature of the first clutch; and

a second compression spring positioned between the first clutch and the second clutch, the second clutch being biased by the compression spring in a direction away from the first clutch.

15. The mortise lock cylinder of claim 14, characterized in that the first compression spring and the second compression spring are configured such that a force

generated by the second compression spring is lower than the force generated by the first compression spring.

16. A method for operating a mortise lock cylinder, including:

providing a turn -piece assembly including a turn-piece and a first clutch, the turn-piece being in driving engagement with the first clutch;

providing a keyed cylinder assembly configured to be operable by a key, the keyed cylinder assembly including a second clutch and a plug body having a keyway, the plug body being in driving engagement with the second clutch;

providing a housing for receiving a first portion of the turn-piece assembly and receiving a second portion of the keyed cylinder assembly, the housing having a central portion with a cam slot;

providing a cam in the cam slot mounted to each of the first portion of the turn-piece assembly and the second portion of the keyed cylinder assembly;

permanently drivably engaging the cam with the first clutch such that the cam is always rotatable by the turn-piece; and

drivably coupling the second clutch to the cam via the first clutch when the key is inserted into the keyed cylinder assembly characterized by drivably engaging the first clutch with the second clutch to effect rotation of the cam by the second clutch;

longitudinally displacing the first clutch when the key is inserted into the keyway of the plug body if a protruded feature of the second clutch is not rotationally aligned with a slot feature of the first clutch; and

rotating the key to rotationally align the protruded feature of the second clutch with the slot feature of the first clutch such that the second clutch drivably engages the first clutch.