Nov. 23, 1971 T. J. SARGENT 3,621,685

CYLINDRICAL LOCK

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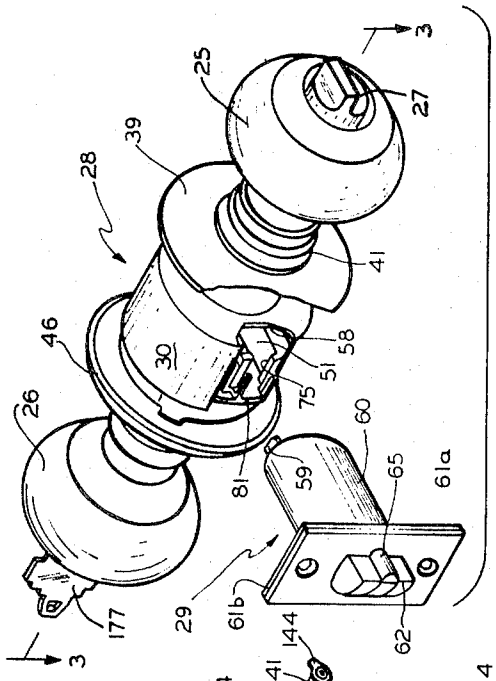

Fig. 1

Fig. 2

INVENTOR.
THOMAS J. SARGENT

BY

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his atty's

Nov. 23, 1971 T. J. SARGENT 3,621,685

CYLINDRICAL LOCK

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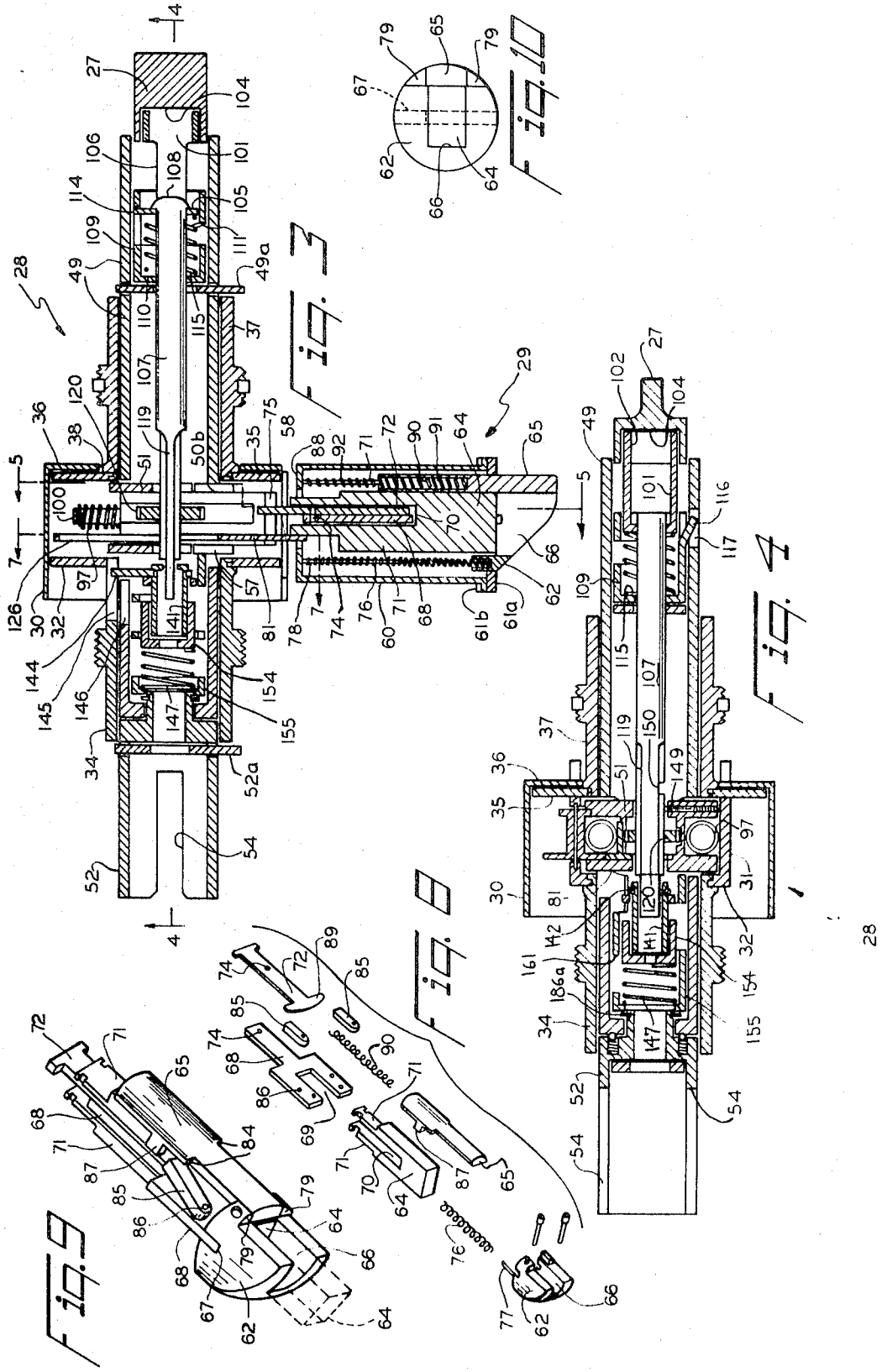

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CYLINDRICAL LOCK

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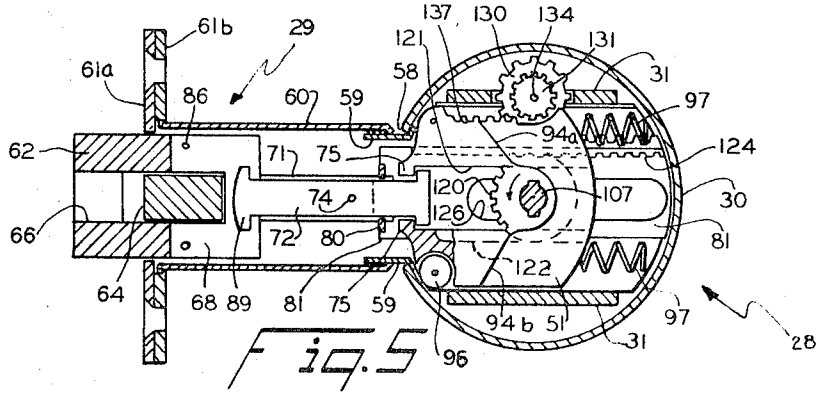

Fig. 5

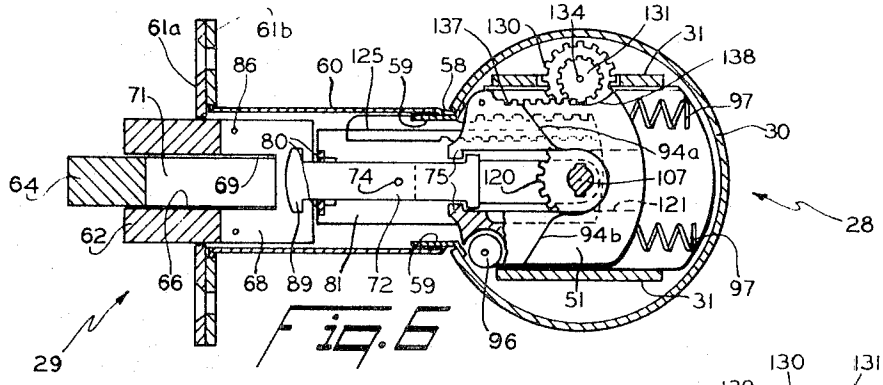

Fig. 6

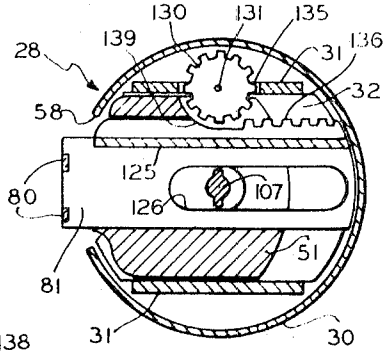

Fig. 7

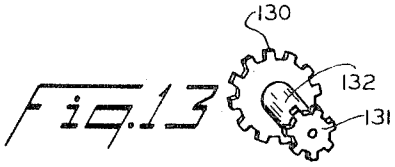

Fig. 13

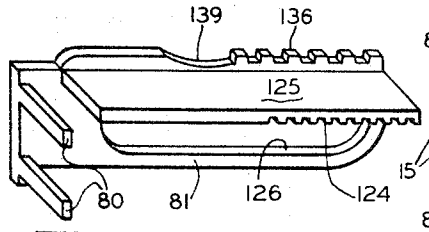

Fig. 12

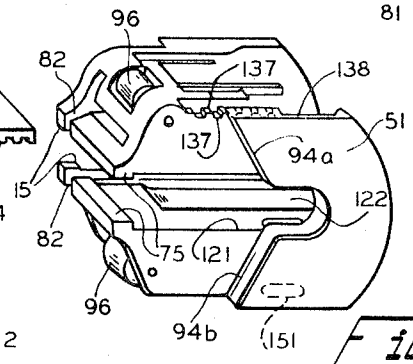

Fig. 11

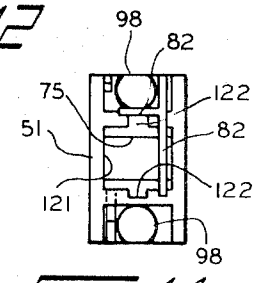

Fig. 14

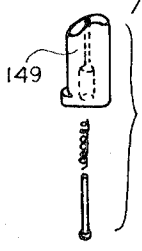

Fig. 15

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CYLINDRICAL LOCK

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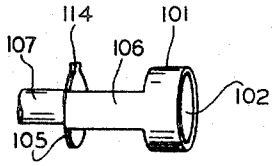

Fig. 17

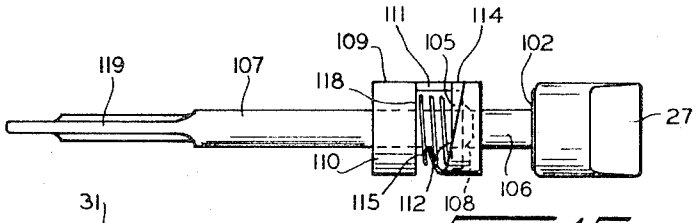

Fig. 16

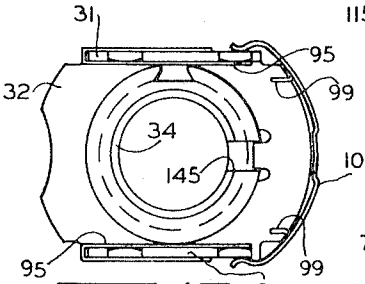

Fig. 18

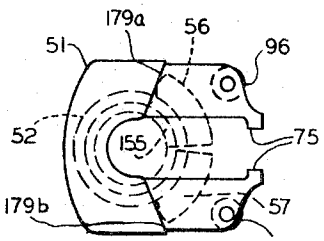

Fig. 20

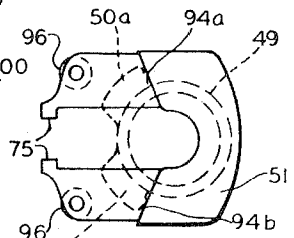

Fig. 19

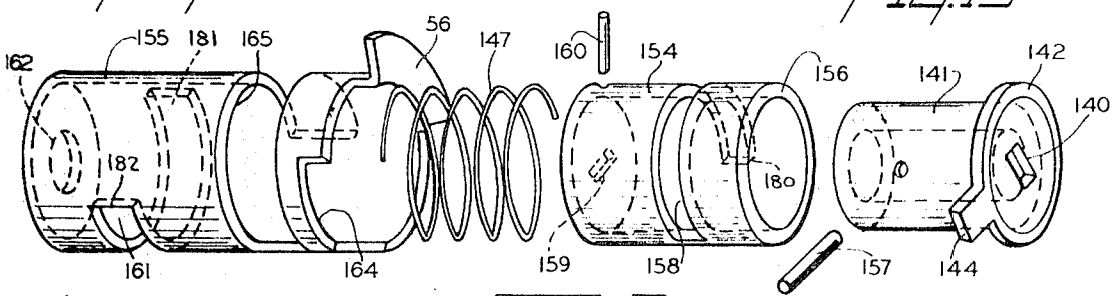

Fig. 21

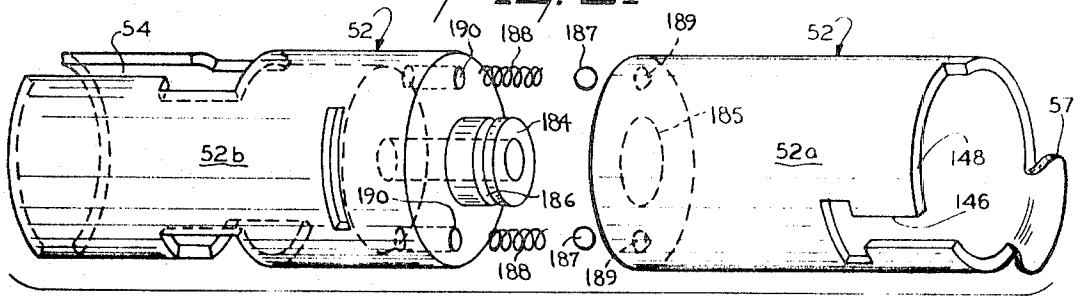

Fig. 22

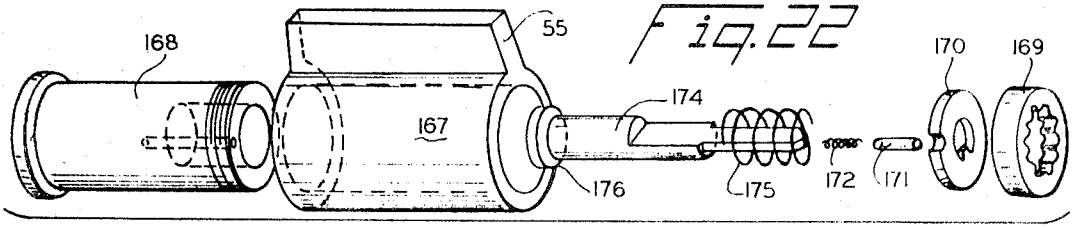

Fig. 23

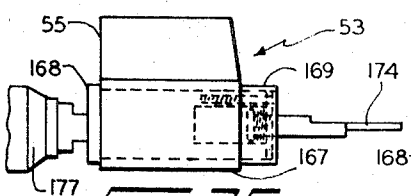

Fig. 25

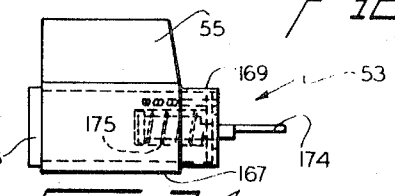

Fig. 24

United States Patent Office 3,621,685 Patented Nov. 23, 1971

3,621,685

CYLINDRICAL LOCK

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Filed Oct. 1, 1969, Ser. No. 862,772
Int. Cl. E05b 59/04; E05c 9/12
U.S. Cl. 70—107 12 Claims

ABSTRACT OF THE DISCLOSURE

A cylindrical lock having a deadbolt and a guarded latchbolt, the deadbolt being actuated by turn button means on the inside and key means on the outside. The deadbolt projects a substantial distance beyond the latchbolt when both are in fully projected position providing an added safety feature. Also provided are a pick-proof cylinder unit and a spinning knob arrangement for frustrating entry by forcing the outside knob.

BACKGROUND OF THE INVENTION

This invention relates generally to door locks, and has particular reference to a cylindrical lock having, in addition to its latchbolt, a deadbolt and a guardbolt whereby a safer than conventional cylindrical lock is provided.

In commercially available hotel function mortise locks, guard means are provided for the latchbolt as well as providing a deadbolt and sometimes stop-works. Mortise locks, however, are relatively expensive and difficult to install and for this reason, less expensive and easier to install cylindrical type locks are frequently used in apartment buildings, housing units and the like. Unfortunately, cylindrical locks have the disadvantage of not being as safe as mortise locks because, while they may have either a deadbolt or guard means for the latchbolt, none have both insofar as applicant is aware. One readily apparent reason for this is that the cylindrical latch case of a cylindrical type lock has a very limited amount of space making it difficult to fit a latchbolt, a deadbolt and a guardbolt within its interior.

The closest prior art known to the applicant is U.S. Pat. No. 3,018,651 granted Jan. 30, 1962 to D. Morrison, Jr. for Lock. This patent discloses a cylindrical type lock having a deadbolt but no guard means is provided for the latchbolt. Therefore, if the outside knob has been locked without having moved the deadbolt into locking position, it might still be possible for an intruder to gain entry by forcing the latchbolt to retract using a thin, flat instrument such as a nail file or credit card in a manner known to those familiar with the art.

SUMMARY OF THE INVENTION

The cylindrical lock of the invention offers all of the features of a hotel function mortise lock without unduly complicating the lock structure or making it any more difficult to install. The latch case contains, in addition to the latchbolt, both a deadbolt and a guardbolt, the latter preventing unauthorized entry in the manner described above when the outside knob has been locked and the deadbolt has not. The deadbolt has the advantage that it extends outwardly a substantial distance beyond the latchbolt when both are in fully projected position. This provides an added safety factor over, for example, the deadbolt of the Morrison patent which can extend no farther than the latchbolt because of the manner in which the two bolts and their respective retractors are arranged.

In addition to its novel latch assembly, the lock to be disclosed herein has an essentially pick-proof cylinder unit whereby even if someone succeeds in aligning the tumblers so that the cylinder can be rotated, no lock function will occur. Thus, the cylinder unit does not become operatively connected to the lock works until the key is fully inserted in the unit. Another feature of the lock of the invention is its spinning knob arrangement wherein the sleeve to which the outside knob is secured is formed of two parts that are normally rigidly connected together but capable of movement relative to one another in the event that the knob has been locked and an extreme turning force is thereafter applied to it as by means of a pipe wrench.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of the latch and lock assemblies of the cylindrical lock of the invention;

FIG. 2 is an exploded view of the essential parts of the two assemblies of FIG. 1;

FIG. 3 is a horizontal section through the assembled lock taken substantially on line 3—3 of FIG: 1;

FIG. 4 is a vertical axial section through the lock taken substantially on line 4—4 of FIG. 3;

FIGS. 5 and 6 are vertical cross sections through the assembled lock taken substantially on line 5—5 of FIG. 3, FIG. 5 showing the deadbolt in retracted position and FIG. 6 showing it in projected position;

FIG. 7 is a vertical cross section through the lock taken substantially on line 7—7 of FIG. 3;

FIG. 8 is an exploded view of the latchbolt, deadbolt and guardbolt assemblies;

FIG. 9 is a perspective view of the assembly of FIG. 8;

FIG. 10 is a front end elevation thereof;

FIGS. 11 and 12 are enlarged perspective views of the latchbolt and deadbolt retractors, respectively;

FIG. 13 is an enlarged perspective view of the retractor gear and pinion detail;

FIG. 14 is an enlarged rear elevation of the latchbolt retractor;

FIG. 15 is an enlarged exploded view of the detent mechanism for the turn button spindle;

FIG. 16 is a side elevation of the turn button subassembly;

FIG. 17 is a perspective view of one part of the subassembly;

FIG. 18 is an end elevation of the outside cap and hub;

FIG. 19 is a right side elevation of the retractor showing in dash lines the position of the inside actuator sleeve relative thereto;

FIG. 20 is a left side elevation of the retractor showing in dash lines the position of the outside actuator sleeve relative thereto;

FIG. 21 is an exploded view of an interior sub-assembly of the outside actuator sleeve;

FIG. 22 is an exploded view of the exterior parts of the outside actuator sleeve;

FIG. 23 is an exploded view of the key cylinder unit;

FIG. 24 is a side elevation of the cylinder unit without the key inserted therein; and

FIG. 25 is a view corresponding to FIG. 24 but with the key inserted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the cylindrical lock shown in FIG. 1, the inside and outside knobs **25, 26** are respectively provided with turn-push button and key means, the turn-push button **27** being capable of both rotational and axial movement but being referred to elsewhere in the specification as simply the turn button. In a manner to be explained hereinafter, the latchbolt can be retracted by turning either knob, pushing the button inwardly locks the outside knob and turning the inside knob or the key in the outside knob automatically releases the turn button. Closing the door does not release the turn button but when the door is closed the latchbolt is automatically dogged by the guardbolt.

When the turn button or key is turned aproximately 180°, the outside knob is locked and the deadbolt is moved into locking position. However, if the inside knob is turned when the deadbolt is in locking position, the latter is automatically retracted whereby immediate exit is always possible. The outside knob can be locked or unlocked by means of the key and similarly, the deadbolt can be locked or unlocked by the key.

As is well known in the art, the lock assembly indicated generally at **28** is positioned in a transverse bore near the free edge of the door (not shown), while the latch assembly indicated generally at **29** is received in a bore that extends from the free edge and intersects the transverse bore. The lock case includes a central housing **30**, FIGS. 1 and 2, that is located wholly within the door, the housing receiving therein the parallel top and bottom flanges **31** of a cap **32** mounted on a hub **34**, see FIG. 2. A second cap and hub is positioned in the housing **30** with the cap **35** abutting against the sidewall **36** of the housing and hub **37** projecting outwardly through a hole **38** in the sidewall.

An inside escutcheon plate **39** is threaded onto hub **37** so that it abuts against the inside surface of the door and the shank **40** of the inside knob is received in an annular space between the end of the hub and a collar **41** on the escutcheon plate, the knob being rotatable relative to both the hub and collar which are normally fixed. A conventional anchor spring **42** and anchor **44** are mounted in the usual manner on the outside hub **34**, the opposing sidewalls **45** of the anchor overlying the cap flanges **31** and being telescopically received in the housing when the parts are assembled. The anchor and anchor spring are optional and do not per se play a part of the present invention.

An outside escutcheon plate **46** is threaded onto the hub **34** so that it abuts against the outside surface of the door. As in the case of the inside knob, the shank **47** of the outside knob **26** is received in an annular space between the end of hub **34** and a collar **48** on the escutcheon plate, the knob being rotatable relative to both parts.

An inside actuator sleeve **49**, FIG. 2, is journalled in the inside hub **37** and projects into the interior of the inside knob **25** so that the turn button **27** carried by the sleeve normally projects through an opening in the knob as shown in FIG. 1. As is conventional, the knob is secured to the sleeve by a spring catch **49***a*, FIG. 3, so that when the knob is turned the sleeve turns with it. At its inner end, the sleeve **49** is formed with a pair of generally radially projecting ears **50***a*, **50***b* and when the parts are assembled, these ears abut against and slide on the inside face of cap **35**. The purpose of the ears is to actuate the latchbolt retractor **51** when the inside knob is turned, as will be more fully described hereinafter.

An outside actuator sleeve **52** is journalled in the outside hub **34** and projects into the outside knob **26** where it telescopically receives the key cylinder unit **53**, FIGS. 24 and 25, the sleeve having a longitudinally extending slot **54** at its outer end to accommodate the radially projecting tumbler pin housing **55**. Like the inside knob, outside knob **26** is secured to the sleeve by a spring catch **52***a*, FIG. 3, whereby the knob and sleeve turn together. Sleeve **52** also has a pair of ears **56**, **57** at its inner end but only one is integral with the sleeve as will be presently explained. The ears **56**, **57** abut against the inside face of cap **32** and like ears **50***a*, **50***b*, their function is to actuate the retractor **51** which is slidably mounted for back and forth movement between the cap flanges **31**.

The housing **30**, FIGS. 1, 2, 5 and 6, is formed with a front opening **58** for communication with the rear end of the latch assembly **29**. Thus, the latch assembly, which is inserted in its bore first during installation, is provided with a pair of diametrically opposed lugs **59** which engage the housing adjacent the upper and lower edges of the opening **58** as the housing is pushed into place in its bore. In this manner the latch and lock assemblies are secured together and maintained in proper registry with one another.

Latch assembly **29** includes a cylindrical latch case **60** and face plates **61***a*, **61***b*, all of which are substantially conventional. Contained within the latch case, FIGS. 3, 5, 6 and 8–10, are the latchbolt **62**, deadbolt **64** and guardbolt **65** arranged with respect to one another as best shown in FIGS. 8 and 9. The bevelled latchbolt is formed with a relatively large, axially extending channel **66** which extends, in the widthwise direction, from one side of the bolt approximately ¾ of the way thereacross as indicated by FIG. 10. On its back side, latchbolt **62** is formed with a centrally disposed vertical slot **67** in which the forward end portions of a bifurcated plate **68** are pinned or otherwise secured.

The space **69** between the end portions or arms of the plate **68** is equal in width to the height of the latchbolt channel **66** and forms a rearward extension thereof. The deadbolt **64** is slidably mounted in the channel and is provided with a vertical slot or channel **70** in which the center portion of the plate **68** is received. With this arrangement, the arms **71** on either side of the deadbolt slot extend rearwardly on opposite sides of the center portion of plate **68** while the arms of the latter extend forwardly above and below the unslotted forward end of the deadbolt. Rearward movement of the deadbolt is thus limited by engagement of the end of its slot with the end of the space **69** between the arms of the plate.

A rocker arm **72** is pivotally connected at **74** to the rear end of plate **68**, and the T-shaped rear end of the arm interengages with a loose fit shoulders **75** at the forward end of the retractor **51**, FIGS. 5, 6 and 11. Rearward movement of the retractor thus operates through the arm **72** and plate **68** to withdraw or retract the latchbolt **62**, the latter being normally biased into its outwardly projecting or latching position by a compression spring **76**, FIGS. 3 and 8, the opposite ends of which embrace a rearwardly extending pin **77** on the latchbolt and a forwardly extending pin **78** in the latch case. The biasing action of spring **76** is aided by a corresponding guardbolt spring to be presently described. Forward or outward movement of the latchbolt is limited by shoulders **79** thereon, FIGS. 9 and 10, which abut against the back of the face plate **61***a*. Thus, as best shown in FIG. 1, the opening in the face plate is shaped so that only the guardbolt **65** and the portion of the latchbolt forward of the shoulders **79** can project through the opening.

The deadbolt **64** can be moved independently of the latchbolt and to this end, the rearwardly extending arms **71** of the deadbolt are notched for interengagement with a pair of spaced fingers **80** at the forward end of an actuator member **81**, FIGS. 5, 6 and 12. The actuator **81** is slidably mounted in a way **82** in the retractor **51** and can be moved longitudinally by means described hereinafter to project or retract the deadbolt. In either extreme position of the actuator, however, its forward end and fingers **80** are always in front or outward of the forward end of the retractor as shown in FIGS. 5 and 6.

The guardbolt **65** has a flat side and an arcuate side as shown in FIG. 10, and the flat side engages a side of the deadbolt **64**, FIGS. 8 and 9. The forward portion of the guardbolt is reduced in height and fits between the latchbolt shoulders **79**, the guardbolt being slidable longitudinally relative to both the latchbolt and deadbolt. Forward movement of the guardbolt is limited by shoulders **84** on the upper and lower edges thereof which abut against the back side of the latchbolt shoulders **79**. When such abutment occurs, the forward end of the guardbolt is flush with the forward end of the latchbolt as shown in FIGS. 1 and 3.

In order to dog or deadlock the latchbolt **62**, the guardbolt **65** must be in the position shown in FIG. 9 wherein it is retracted with respect to the latchbolt. As

is well known in the art, the guardbolt is adapted to be held in this position by the strike (not shown) on the door jamb when the door is closed. When the guardbolt is retracted and the latchbolt is not, a dog **85** that is pivotally connected at **86** to the bifurcated plate **68** falls down in front of a laterally projecting lug **87** on the guardbolt which lug overlies the top of the right arm **71** of the deadbolt, as viewed in FIGS. 8 and 9. With the dog **85** in this position (and assuming that the outside knob has been locked), the latchbolt cannot be pushed into retracted position by slipping a flat instrument between the door edge and strike because the engagement of the dog with the lug prevents rearward movement of the latchbolt relative to the guardbolt. Moreover, the guardbolt cannot be forced back with the latchbolt because in its retracted position shown in FIG. 9 it is already back as far as it can go with its rear end against the rear wall **88**, FIG. 3, of the latch case **60**.

There is a lower dog **85** and lower lug **87** so that the lock will be reversible. The upper and lower lugs **87** on the guardbolt engage the upper and lower surfaces of the deadbolt arm **71** and help to guide the guardbolt in its longitudinal movement. The deadbolt channel **70** is wide enough to accommodate both the center portion of the bifurcated plate **68** and the forward portion of the rocker arm **72** with a clearance fit. When the parts are assembled, the forward hammer-headed end **89** of arm **72** is positioned near the end of the deadbolt channel, FIG. 3, and when the dog **85** drops down in front of the lug **87** it also depresses this hammer-head causing the forward portion of the arm to be rocked downwardly through a small angular increment permitted by the loose fit between the rear end of the arm and shoulders **75** on the retractor **51**.

With the arrangement described above, whenever the retractor is moved rearwardly, as by turning the inside knob, the horizontal force on the rear end of the rocker arm causes it to rock back into horizontal position whereby the hammer-head **89** lifts the dog **85** out of engagement with the guardbolt lug **87**. Disengagement of the dog from the lug enables a compression spring **90**, which was compressed by the retraction of the guardbolt, to start to move the guardbolt forwardly. One end of the spring **90**, FIGS. 3 and 8, is received in a bore **91** in the guardbolt while the other end embraces a pin **92** in the latch case. As the guardbolt moves forward, it is met by the rearwardly moving latchbolt **62** which is being positively retracted by the turning action of the knob on retractor **51**. The shoulders **79** on the latchbolt thus engage the shoulders **84** on the guardbolt so that both are fully retracted and the door can be opened.

After the door has been opened and the knob released, both the latchbolt and guardbolt are returned to their outwardly projecting positions shown in FIGS. 1 and 3 by their respective compression springs **76** and **90** with the latter aiding the former, as previously noted. In normal operation, any time the guardbolt is not held in retracted position by the strike, retraction of the latchbolt will effect simultaneous retraction of the guardbolt due to the engagement of their respective shoulders **79** and **84**. Thus, for example, whenever the door is closed by simply pushing it, the strike forces the bevelled latchbolt to retract which in turn causes the guardbolt to retract.

As noted above, turning the inside knob **25** in either direction operates through the inside actuator sleeve **49**, FIG. 2, to retract the latchbolt **62**. More specifically, the ears **50***a*, **50***b* on the inner end of the sleeve engage camming edges or shoulders **94***a*, **94***b* on the side of the retractor **51**, FIGS. 11 and 19, and cause the retractor to move rearwardly; the rearward movement of the retractor is transmitted through rocker arm **72** and bifurcated plate **68** to the latchbolt. FIG. 19 illustrates the relationship between the right side (with respect to FIG. 2) of the retractor and the ears **50***a*, **50***b*, the latter together with sleeve **49** being shown in dash lines. As will be apparent, clockwise rotation of the knob and sleeve will cause ear **50***a* to push against the camming edge **94***a* and move the retractor rearwardly, while counterclockwise rotation will cause ear **50***b* to push against camming edge **94***b* to achieve the same result.

The cap flanges **31** between which the retractor **51** is positioned are lined with bearing metal strips **95**, FIG. 18, and the retractor is provided with upper and lower rollers **96** to facilitate its back and forth movement. When either knob is released after being turned to retract the latchbolt, the retractor is immediately returned to its normal forward position by a pair of compression springs **97**, FIGS. 3–6. The forward ends of these springs are positioned in bores **98**, FIG. 14, in the rear wall of the retractor and the rear ends thereof are held in position by tabs **99** on a spring clip **100**, FIG. 18, that engages the cap flanges **31**.

The actuator sleeve **49** carries a turn button subassembly, FIGS. 3. 4, 16 and 17, which includes a cup or tube **101** having one closed end. The open end **102** of this cup is rigidly secured as by a press fit in a recess **104** in the turn button **27** and in between the turn button and the closed end **105** of the cup, the cup is cut away on opposite sides so that the ends **102** and **105** thereof are connected only by a pair of relatively narrow sidewall strips **106**, see FIG. 17. The end wall **105** of the cup has an opening in which the end of a spindle **107** is inserted, the spindle end being swaged over the wall as indicated at **108** in FIGS. 3 and 16 so that the turn button, cup and spindle are all rigidly connected together.

The end **105** of the cup **101** is telescopically received in a second cup **109** the closed end **110** of which has a central hole through which the spindle **107** passes with a free fit. Cup **109** is provided with a sidewall opening or cut-out **111** having a helically disposed camming edge **112**. The end **105** of cup **101** is formed with a small lug **114** which projects into the opening **111**, and a compression spring **115** positioned in cup **109** between its bottom and the end **105** of cup **101** biases the lug into engagement with the camming edge.

The cup **109** of the turn botton sub-assembly is telescopically received in the actuator sleeve **49** and is secured thereto by bending a tab **116**, cut from the cup wall opposite opening **111**, outwardly into a corresponding opening **117** in the sleeve as shown in FIG. 4. With this arrangement of parts, the turn button sub-assembly will turn with the sleeve when the latter is turned by the inside knob, but movement of the turn button **27** entirely independent of the knob is also possible. Thus, the turn button can be pushed inwardly against the action of spring **115** until the lug **114** contacts the inner edge **118** of the opening **111**, FIG. 16. The turn button can also be turned (in the counter-clockwise direction as viewed from the right end of FIG. 16) through approximately 180°, the angular extent of the opening **111**, and at the same time it will be caused to move inwardly because lug **114** is riding on camming edge **112** as the button is being turned.

The turn button spindle **107** has a splined portion **119** which passes with a sliding fit through a gear **120** having a corresponding opening, FIGS. 3–6. The gear is positioned in a central opening **121** in retractor **51**, the top and bottom walls of the opening being formed with oppositely disposed channels **122**, FIGS. 5, 11 and 14, to provide clearance for the gear. The previously mentioned way **82**, formed in the retractor to slidably receive deadbolt actuator **81**, has intersecting horizontal and vertical legs, being essentially in the shape of a sidewise T as best shown in FIGS. 11 and 14. The upper channel **122** for gear **120** opens into the horizontal leg of the way permitting the gear to mesh with a rack **124** on the underside of a horizontal plate **125** which forms a part of the actuator **81** and is received in the horizontal leg of the way.

With the arrangement described, turning the turn button **27** counterclockwise through approximately 180° will rotate gear **120** correspondingly and drive actuator **81** outward relative to the retractor, the actuator having a central longitudinal slot **126** to accommodate the turn button spindle which extends beyond the gear for a purpose to be explained. The movement of the actuator positively drives deadbolt **64** outwardly, the latter being moved from its retracted position shown in FIGS. 3 and 5 to its fully projected position shown in FIG. 6 (and by dash lines in FIG. 9). As will be apparent from FIGS. 6 and 9, the deadbolt in fully projected position extends a substantial distance beyond the latchbolt **62** in fully projected position making the lock safer because forceable entry is rendered more difficult. The unusually long projection or throw of the deadbolt is possible because of its being centrally disposed in the latchbolt and because it is connected to its actuator at a point forward of the connection between the retractor and rocker arm **72**.

As gear **120** is rotated in the course of projecting the deadbolt, its teeth ride past a tooth **127** on a pawl **128**, FIG. 2, that is rockably connected adjacent its lower edge to the back part of retractor **51** and biased into engagement with the gear by a spring **129**. The pawl tooth prevents rotation of the gear in the opposite or clockwise direction whereby the deadbolt is positively held in projected position. The deadbolt can, however, be immediately retracted from deadlocking position by simply turning the inside knob **25** in either direction whereby immediate exit from inside is always possible.

To this end, a pair of gears **130, 131** are fixed on opposite ends of a sleeve **132**, FIGS. 2, 4–7 and 13, rotatably mounted on a shaft **134** that spans an opening **135** in the top flange **31** of cap **32**. The gears are thus positioned in the opening for rotation on the shaft, and the larger gear **130** is adapted to mesh with a rack **136** on the top edge of the vertical portion of the actuator **81**, FIGS. 4–7 and 12. The smaller gear **131** is adapted to mesh with a rack **137** formed in the top of the retractor **51** whereby rearward movement of the retractor, FIGS. 11–13, as caused by turning a knob, rotates gears **130, 131** in the counterclockwise direction whereby the latter drives the actuator rearwardly and retracts the projecting deadbolt. Rearward movement of the retractor withdraws the pawl tooth **127** from gear **120** and permits it to rotate as the actuator **81** moves back. Since the normal length of travel of the retractor is only one-half of that needed to retract the fully projected deadbolt, the larger gear **130** has twice as many teeth as gear **131** so that the rearward movement of the actuator is twice as fast as that of the retractor.

As best shown in FIGS. 5–7, 11 and 12, there is a dwell area **138** just to the rear of the retractor rack **137** and a dwell area **139** just forward of the actuator rack **136**. When the retractor is in its normal forward position and the actuator in its normal rear position, FIGS. 5 and 7, gear **130** extends into dwell area **139** and gear **131** into dwell area **138**. This arrangement is provided because if the actuator is in retracted position and the retractor is moved rearwardly as by turning a knob, the retractor rack **137** will be moved into engagement with gear **131** causing both gears to be driven in the counterclockwise direction. However, since further rearward movement of the actuator is not possible, dwell area **139** permits gear **130** to turn without effecting movement of the actuator. Similarly, if the retractor is in normal forward position and it is desired to project the deadbolt by turning the turn button **27**, the forward movement of the actuator caused by gear **120** will move it rack **136** into engagement with gear **130** causing both gears to be driven in the clockwise direction. In this case, since further forward movement of the retractor is not possible, dwell area **138** permits gear **131** to turn without affecting the retractor. As described above, inter-action of the retractor and actuator does occur through gears **130, 131** when the deadbolt is in its projected position and the retractor is moved rearwardly as by turning a knob.

The inner end of the turn button spindle **107** is rectangular in cross section, FIG. 16, and projects into a conforming slot **140** in the closed end of a cup **141** that is a part of the outside actuator sleeve assembly to be described, see FIGS. 3, 4 and 21. A ring **142** is rotatably mounted on the closed cup end and has a radially projecting tab **144** that lies in a slot **145** formed in the outside hub **34**, FIG. 18. The slot **145** is in registry with a slot **146**, FIG. 22, at the inner end of the outside actuator sleeve **52** when the latter is in its normal position with the latchbolt fully projected.

Cup **141**, with associated parts to be described, is positioned in the inner end of sleeve **52** and is movable longitudinally relative thereto. The cup is normally biased by a compression spring **147** into a position in which its ring tab **144** is in the hub slot **145** but not in the sleeve slot **146**, the tab being opposite the edge sector **148** of the sleeve. When the cup is in this position, the turn button **27** is in its normal outermost position as indicated in FIGS. 3, 4 and 16. When the push button is pushed inwardly until lug **114** contacts the inner edge **118** of the opening **111**, cup **141** is moved by the turn button spindle farther into the sleeve **52** causing the tab **144** to enter the sleeve slot **146**. Since the tab now bridges the hub and sleeve slots **145, 146**, this locks outside knob **26** because it is fixed on the sleeve. In the same manner, the outside knob is locked when the turn button is turned to project the deadbolt because as it turns it also moves inwardly due to the engagement of lug **114** with the camming edge **112**.

When the turn button is pushed inwardly to lock the outside knob, it is held in locking position by the entry of a spring biased detent **149**, FIGS. 4 and 15, into a notch **150** in the turn button spindle **107**, which notch comes into registry with the detent at the limit of the inward movement of the button. The detent is carried in a correspondingly shaped opening **151**, FIG. 11, in the retractor **51** and is normally held in depressed position by the unnotched part of the spindle as shown in FIG. 4. When the retractor is moved rearwardly as by turning the inside knob, the detent moves with it, out of engagement with the spindle notch, whereupon the turn button and spindle are returned to their normal outer position by the action of springs **115** and **147**. The outside knob is thus always unlocked by turning the inside knob.

When the outside knob is locked simultaneously with the projecting of the deadbolt, the turn button is maintained in the inner position into which it is cammed by engagement of the pawl **128** with gear **120**, FIG. 2. Rearward movement of the retractor by the inside knob moves the pawl back out of engagement with the gear and the rearward movement of the actuator **81**, through the action of gears **130, 131**, rotates the gear **120** in the reverse direction. This causes the spindle and turn button to return to their outer position thereby unlocking the outside knob. The return movement of the turn button and spindle is aided by the action of springs **115** and **147** as described just above.

The outside actuator sleeve **52** is made in two parts **52*a*, 52*b*** for a purpose to be described, and carries in its inner end portion **52*a*** the key lock sub-assembly, FIGS. 2, 21 and 22. This sub-assembly comprises three telescopically assembled coaxial cups **141, 154** and **155** which are rotatable relative to one another. Cup **141**, described above, is received in cup **154** and is held therein with its ring **142** abutting against the edge **156** of the cup by means of a retaining pin **157** that rides in a circumferential slot **158** in cup **154**. The closed end of cup **154** has a rectangular opening **159**, and this cup is received in cup **155** with the compression spring **147** interposed between the closed ends of the two cups. Cup **154** is held

in position in cup **155** by a retaining pin **160** that projects into a slot **161** in the outer cup.

The closed end of cup **155** has a circular hole **162** with a diameter that is slightly larger than the length of the slot **159** in cup **154**. Cup **155** has the previously mentioned ear **56** at its inner end and is rotatably received in the inner end portion **52***a* of the sleeve **52** with its ear **56** adjacent the sleeve ear **57**, as indicated in FIGS. 2 and 20, and its inner end cut away sector **164** behind the sleeve slot **146**. When the lock is assembled, the ring tab **144** lies in slot **145** in the hub **34** as previously described, and the sleeve slot **146** and sector **164** are in registry therewith.

When the cup **141** is pushed inwardly by the push button spindle **107**, it moves farther into cup **155**, carrying cup **154** with it. The cut away sector **164** accommodates the ring tab **144** during such movement allowing it to enter the sleeve slot **146** without being obstructed by cup **155**. Retaining pin **157** projects through slot **158**, beyond the wall of cup **154**, and into a registering slot **165** in cup **155**. The slots **161** and **165** in cup **155** are substantially wider than required for free rotation of the retaining pins **160** and **157** to enable the pins to move axially with respect to cup **155** when cups **141** and **154** are pushed inwardly relative to cup **155** as just described.

The key cylinder unit **53** includes a cylinder body **167**, cylinder plug **168**, and cylinder cap **169**, all of which are conventional. Coacting with the cap in a known manner is the cylinder driver **170** and associated cap pin **171** and cap spring **172**. The cylinder unit also includes a cylinder bar **174** and, in accord with the invention, this bar is slidable longitudinally in the cylinder body **167** and is normally biased into a retracted position, as shown in FIG. 24, by a compression spring **175** which encircles the bar between a flange **176** at its inner end and the driver **170**. When the proper key **177** is inserted in the unit far enough to turn the cylinder plug, the inner end of the key pushes the cylinder bar outwardly to the position shown in FIG. 25 and the bar turns with the plug because of a spline interconnection (not shown).

As noted above, turning the outside knob **26** in either direction operates through the actuator sleeve **52** to retract the latchbolt **62**. More specifically, the ears **56**, **57** at the inner end of the sleeve engage camming edges or shoulders **179***a*, **179***b* on the left side (as viewed in FIG. 2) of the retractor **51**, FIG. 20, and cause the retractor to move rearwardly. The rearward movement of the retractor is transmitted through rocker arm **72** and bifucated plate **68** to the latchbolt.

FIG. 20 illustrates the relationship between the left side of the retractor and ears **56**, **57**, the latter together with sleeve **52** and cup **155** being shown in dash lines. As will be apparent, clockwise rotation of knob **26** will operate through sleeve **52**, to which it is secured, and cause ear **57** to push against the camming edge **179***b* and move the retractor rearwardly. Counterclockwise rotation of the knob will cause the ear **57** to move in the opposite direction and carry with it ear **56**, against which it normally bears, causing the latter to push against camming edge **179***a* to achieve the same result. The ear **56**, as has been described, is on cup **155** which is rotatably received in sleeve **52** but is not otherwise connected thereto in order to permit various key functions, to be described.

When the cylinder bar **174** of the key cylinder unit is moved by key **177** so that it projects farther out of the unit, FIGS. 24 and 25, the flattened inner end of the bar enters the correspondingly shaped slot **159** in the closed end of cup **154**. With this arrangement, turning the key normally operates to turn the cup.

If the outside knob **26** is locked by pushing in the turn button **27**, the key can be turned to unlock the knob. As described above, the knob is locked because the ring tab **144** has been pushed into slot **146** in sleeve **52** thus bridging the hub and sleeve slots **145**, **146**. If the key is turned in the clockwise direction, FIGS. 2, 20 and 21, the engagement of cylinder bar **174** with cup **154** will cause the latter to turn in the same direction, with its retaining pin **160** moving in slot **161** in cup **155**. When the pin reaches the end of the slot, it will attempt to move cup **155** with it but this cannot be done because ear **56** at the end of the cup is prevented from moving in the clockwise direction, FIG. 20, by the ear **57** on sleeve **52**, the latter being held against movement by the bridging tab **144**.

Turning the key in the counterclockwise direction, on the other hand, will turn cup **154** and its pin **160** in the opposite direction until the pin reaches the other end of slot **161**. When this happens, cup **155** will also be made to turn in the counterclockwise direction whereupon its ear **56** will push against the retractor camming edge **179***a*, FIG. 20, and move the retractor rearwardly which releases the turn button **27** and unlocks the outside knob. During the counterclockwise movement of cup **154**, the end of its slot **158** may pick up retaining pin **157** and cause cup **141** to move with it. This is possible, even though the ring tab **144** has been pushed into the slot **146**, because the cup is rotatable relative to the ring **142**.

The deadbolt **64** can be moved into fully projected position from the outside by turning the key approximately 180° in the clockwise direction. This causes cup **154** to turn in the same direction and as it does so, the end of its slot **158** picks up retaining pin **157** causing cup **141** to turn with it. In this connection, the pin in normal position, with the deadbolt retracted, is located adjacent the far end **180** of slot **158** (as viewed in FIG. 21). When the cup **141** turns in the clockwise direction, the turn button spindle **107** and gear **120** turn with it to drive the deadbolt outwardly as previously described. At the same time, the spindle **107** moves inwardly due to the camming edge **12**, FIG. 16, and pushes ring tab **144** into the slot **146** of sleeve **52** to lock the outside knob.

As the cups **154** and **141** turn in the clockwise direction, their retaining pins **160** and **157** move through substantially the full length of their respective slots **161** and **165** in cup **155**. The turning of the key in the clockwise direction is limited by engagement of the pin **160** with the far end **181** (FIG. 21) of slot **161**, movement of cup **155** in the clockwise direction being prevented by engagement of its ear **56** with ear **57** as described above.

The deadbolt can be retracted by the key by turning it approximately 225° in the opposite or counterclockwise direction. This causes cup **154** to turn in the same direction whereby its retaining pin **160** moves the full length of slot **161** in cup **155**, or through approximately 180°. When the pin reaches the near end **182** (FIG. 21) of the slot, it picks up cup **155** so that the latter is also made to turn in the counterclockwise direction. Both cups continue to move in this direction for approximately another 45° with the result that ear **56** moves retractor **51** rearwardly, FIG. 20, which disengages the pawl **127** from gear **120** and at the same time retracts the deadbolt through the action of gears **130**, **131** and actuator **81**, as previously described. After actuation of the ear **56** to retract the retractor, leeway is provided to permit additional movement of the key, without performing any further lock functions, so that the key can be moved to the upright position in which it must be to remove it from the cylinder unit.

As already noted, the sleeve **52** to which the outside knob **26** is secured is formed in two parts **52***a*, **52***b*, FIGS. 2 and 22. These parts are normally connected together by a boss **184** on part **52***b* which projects into a complementary hole **185** in the otherwise closed bottom of part **52***a*, the boss having a groove **186** for receiving a snap ring **186***a* (FIG. 4) that holds the parts in assembled relation. Relative rotation between the two parts is normally prevented by ball detents **187** biased by springs **188** into recesses **189** in part **52***a* the springs and detents being carried in bores **190** in part **52***b*. Springs **188** are sufficiently heavy so that relative rotation between the parts is pre-

vented under normal conditions but the construction provides the spinning knob feature whereby if an extreme force is applied to the locked outer knob, as by means of a pipe wrench, the ball detents will permit part **52***b* to rotate relative to part **52***a* and the lock will remain locked.

The pick-proof feature of the lock results from the construction of the key cylinder unit **53** wherein the cylinder bar **174** must be projected outwardly by the key before engaging slot **159** in cup **154**. Thus, even if someone without a key succeeds in aligning the tumblers so that the cylinder plug **168** can be rotated, no lock function will occur because the key is needed to operably connect the bar **174** to the remainder of the lock works.

From the foregoing description, it will be apparent that the invention disclosed herein provides a novel and very useful cylindrical lock, the construction of the lock being such that in addition to its own particular novel features it can be readily adapted to perform a variety of conventional lock functions. As will be understood by those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof.

I claim:

1. In a cylindrical lock having coacting latch and lock assemblies: the latch assembly including a normally projecting latchbolt and a normally retracted deadbolt, the deadbolt being centrally disposed in the latchbolt and movable relative thereto; the lock assembly including inside and outside knobs; means in the lock assembly for moving the deadbolt into projecting, locking position and at the same time locking the outside knob; and means responsive to the turning of the inside knob to unlock the outside knob and retract both the latchbolt and the projected deadbolt.

2. A lock as defined in claim **1** wherein said deadbolt in fully projected position extends a substantial distance beyond the latchbolt in fully projected position.

3. A lock as defined in claim **1** wherein the latch assembly includes a guard for the latchbolt.

4. A lock as defined in claim **1** wherein said responsive means includes a retractor for the latchbolt and means actuated by the operation of the retractor to effect the retraction of the deadbolt, said last-named means including a pinion engageable by a rack on the retractor.

5. A lock as defined in claim **4** wherein the lock assembly includes a sleeve having the outside knob secured to one end and having means at its other end engaging the retractor to actuate same when the knob is turned, the sleeve being formed of two parts normally rigidly connected together but capable of being moved relative to one another upon the application of extreme force to the knob.

6. In a cylindrical lock having coacting latch and lock assemblies: the latch assembly including a cylindrical housing and a normally projecting latchbolt, a normally retracted deadbolt and a guardbolt all mounted in the housing; the lock assembly including inside and outside knobs; turn button means in the inside knob and key means in the outside knob both operable to move the deadbolt into projecting, locking position; the deadbolt being arranged and dimensioned with respect to the latchbolt so that it extends a substantial distance beyond the latchbolt when both are in fully projected position; a retractor in the lock assembly actuatable by either knob to retract the latchbolt; and means responsive to the actuation of the retractor to also effect the retraction of the projected deadbolt.

7. A lock as defined in claim **6** wherein said responsive means comprises a pair of gears fixed on opposite ends of a sleeve journalled in the lock assembly, one of the gears being engageable with a rack on the retractor and the other gear being engageable with rack means operatively connected to the deadbolt.

8. A lock as defined in claim **6** wherein said deadbolt is centrally disposed in the latchbolt to enable the guardbolt to abut against one side of the latchbolt.

9. A lock as defined in claim **6** including coacting means on the latchbolt and guardbolt to prevent retraction of the former by the application of a pry force against the bolt itself when the latter is in the guard position, the coacting means being rendered inoperative by actuation of the retractor.

10. A lock as defined in claim **6** wherein the lock assembly includes a sleeve having the outside knob secured to one end and having means at its other end engaging the retractor to actuate same when the knob is turned, the sleeve being formed of two parts normally rigidly connected together but capable of being moved relative to one another upon the application of extreme force to the knob.

11. A lock as defined in claim **6** wherein the key means includes a cylinder unit having a longitudinally movable cylinder bar, and means in the unit to hold the bar in a retracted, inoperable position until the key is fully inserted in the unit.

12. In a lock: a latchbolt; a retractor for the latchbolt; knob means for actuating the retractor; a sleeve member comprising inner and outer interconnected parts; detent means releasably holding the parts against movement relative to one another; the knob means being fixed on the outer part; means on the inner part operably connected to the retractor for actuating same in response to movement of the knob means; and means engageable with the inner part to prevent its actuation of the retractor and thereby lock the knob means; the outer part being movable relative to the inner part, when the knob means has been locked by said actuation preventing means, upon the application of an extreme force to the knob means whereby the means engageable with the inner part continues to be effective to prevent actuation of the retractor.

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