

[54] LOCK ASSEMBLY

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[52] U.S. Cl. 70/276, 70/358, 70/364 A, 70/375, 70/378, 70/403, 70/419

[51] Int. Cl. E05b 27/10

[58] Field of Search 70/276, 358, 364 A, 378, 419, 70/420, 421, 403, 375

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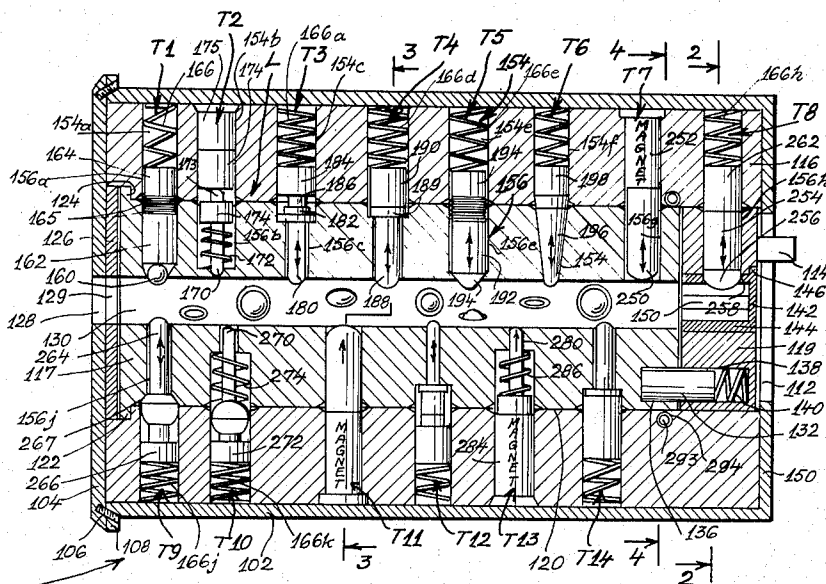
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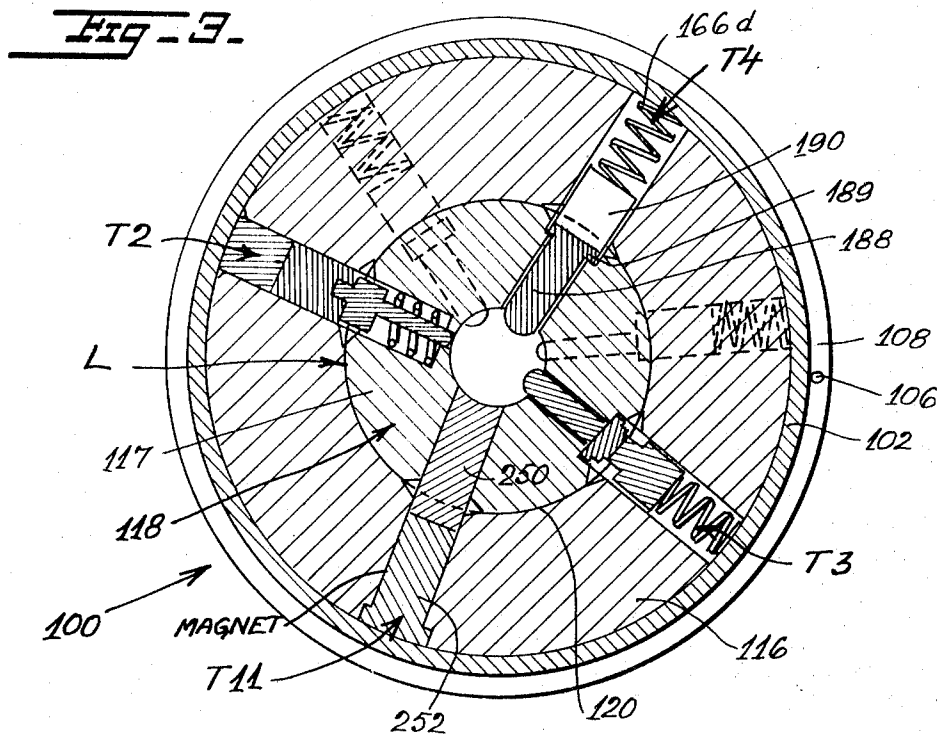
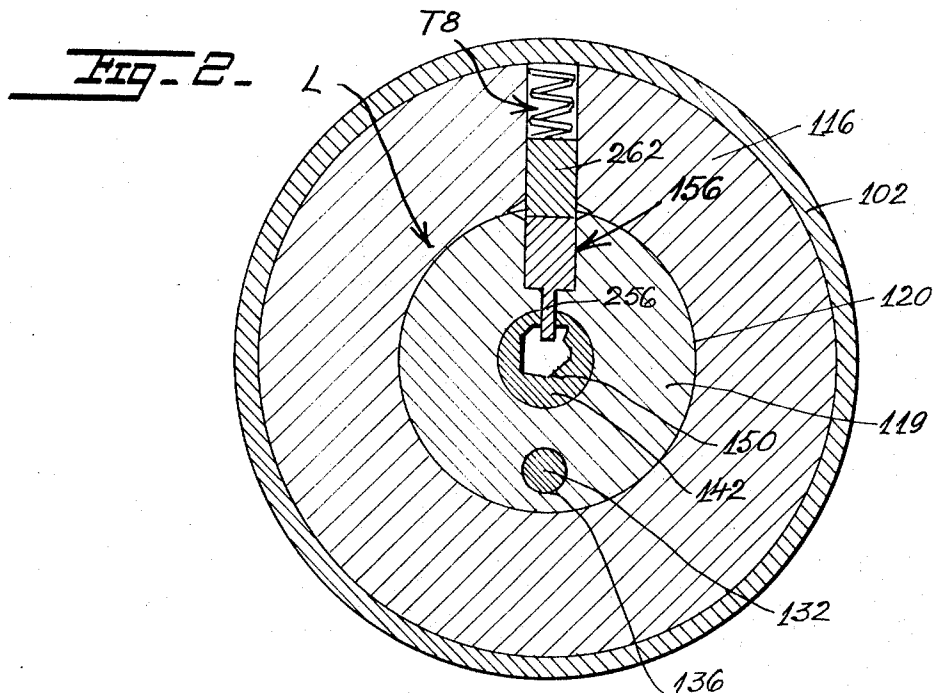
Primary Examiner—Albert G. Craig, Jr.
Attorney—Polachek & Saulsbury

[57] ABSTRACT

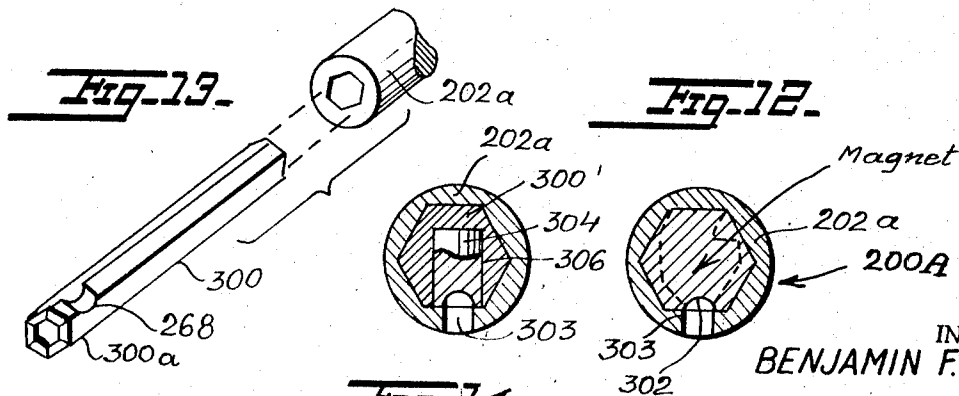
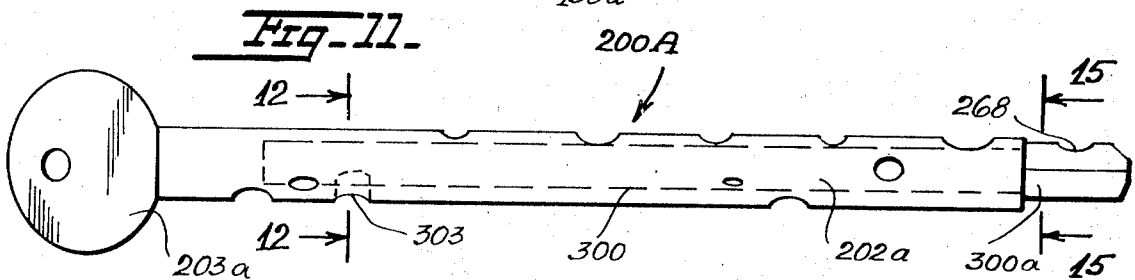
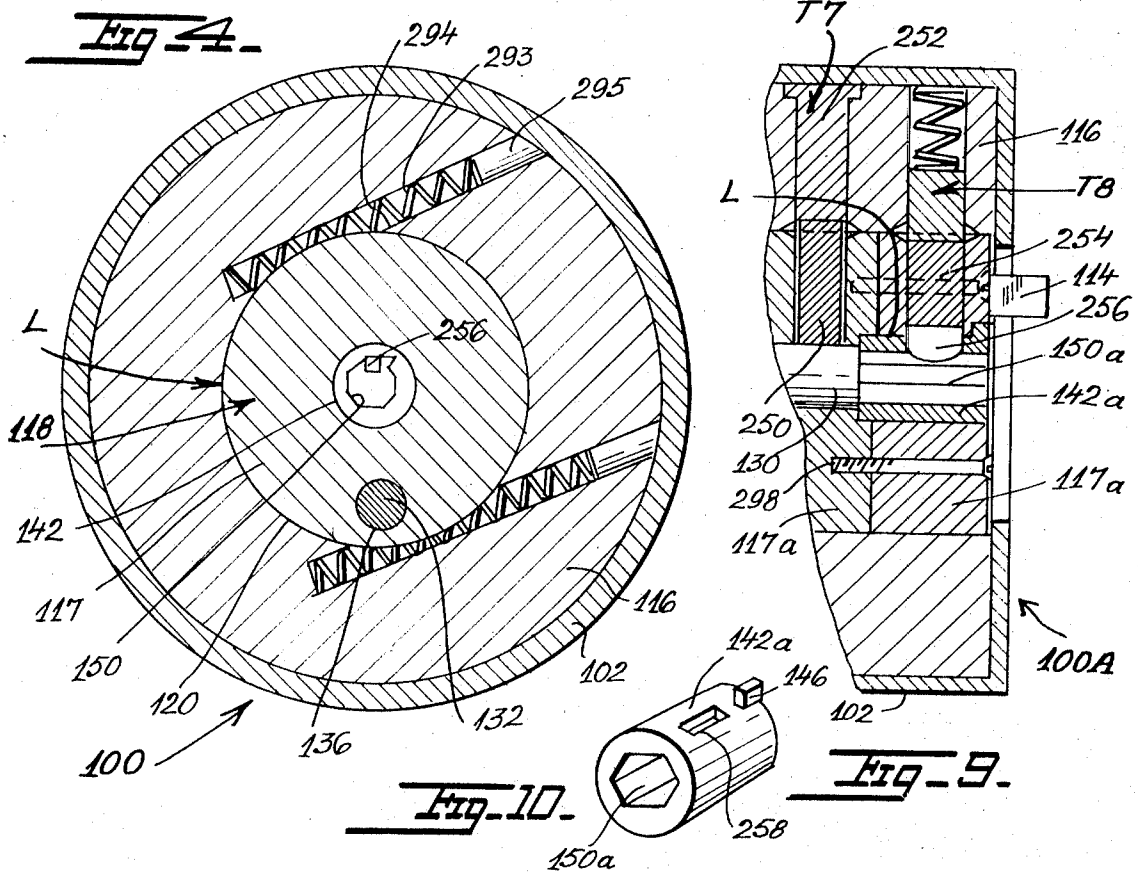
A lock assembly has a stationary barrel. A cylinder having one or more sections is rotatable in the barrel and defines a shear line. Tumbler assemblies in radial bores in the cylinder and barrel are radially and circumferentially spaced. Pins may have different sizes and shapes and may terminate in flat wafer edges exposed to an axial bore in the cylinder. The cylinder receives a key shaft formed with recesses arranged to correspond with the spacing of the tumbler assemblies. Key engaging means is provided at the inner end of the bore in the cylinder to engage an appropriately shaped end of the key shaft. The key shaft may be magnetized to attract magnetic pins of some tumbler assemblies radially into the bore. Radial bores may be countersunk; pins and pin drivers may be ridged and grooved; and spring means can bear tangentially on the cylinder to stabilize it, all to forestall picking of the lock assembly.

18 Claims, 50 Drawing Figures





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Fig. 15. Fig. 16. Fig. 17. Fig. 18.

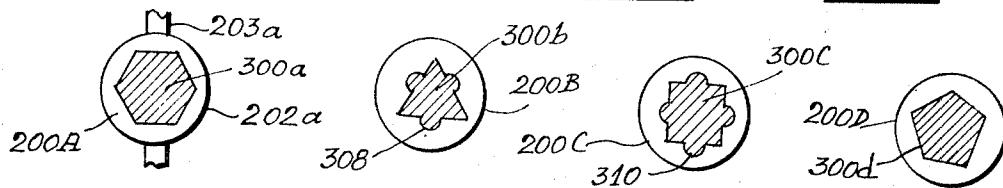


Fig. 19. Fig. 20. Fig. 21. Fig. 22.

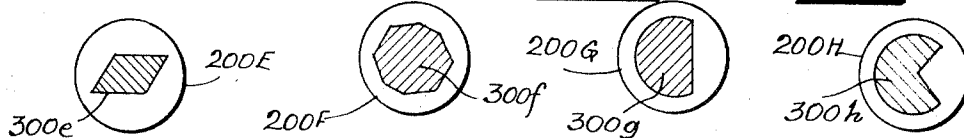


Fig. 23. Fig. 24. Fig. 25. Fig. 26.

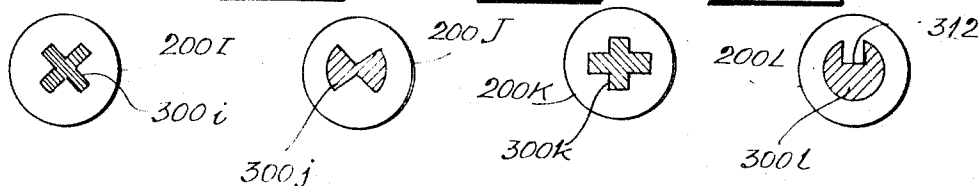


Fig. 29.

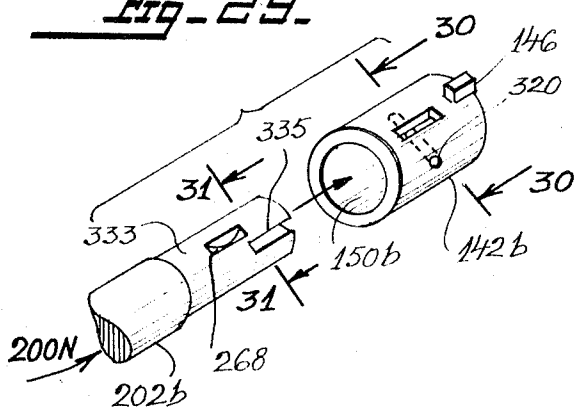
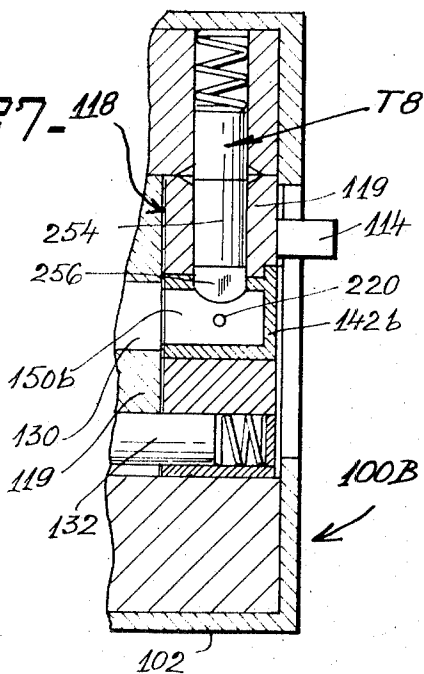


Fig. 27.



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Fig. 28.

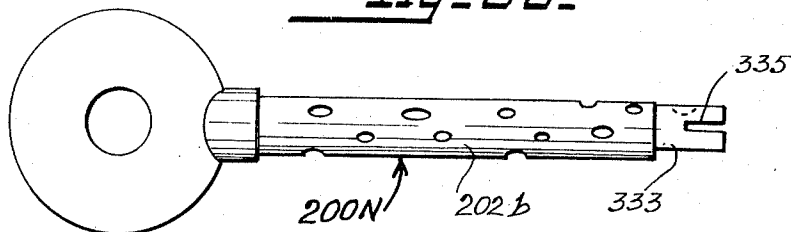


Fig. 31. Fig. 30.

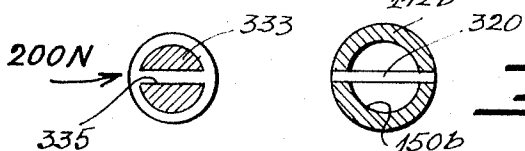


Fig. 42.

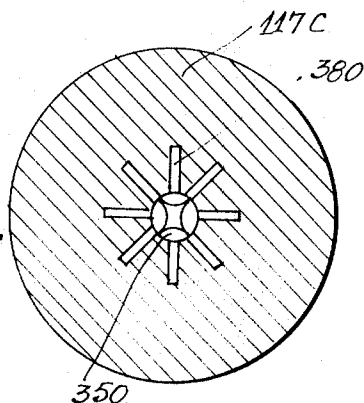


Fig. 32. Fig. 34. Fig. 36.

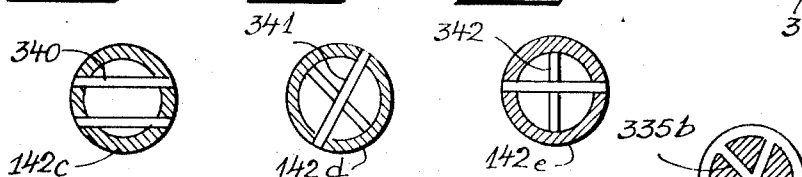


Fig. 38. Fig. 33.

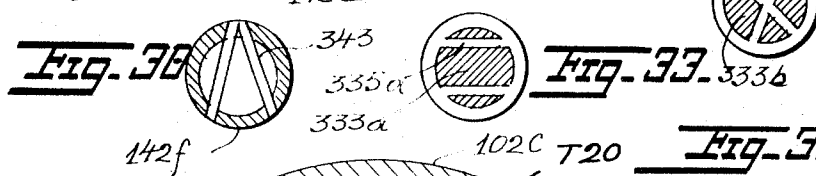


Fig. 39.



Fig. 37.

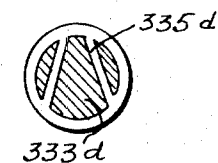
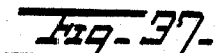


Fig. 39.

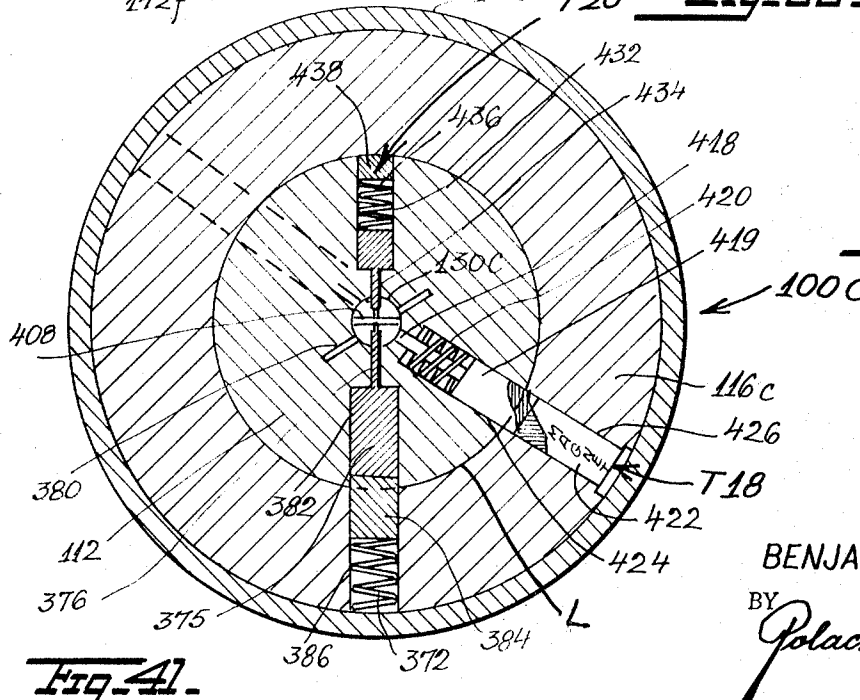
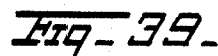


Fig. 41.

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Fig. 40.

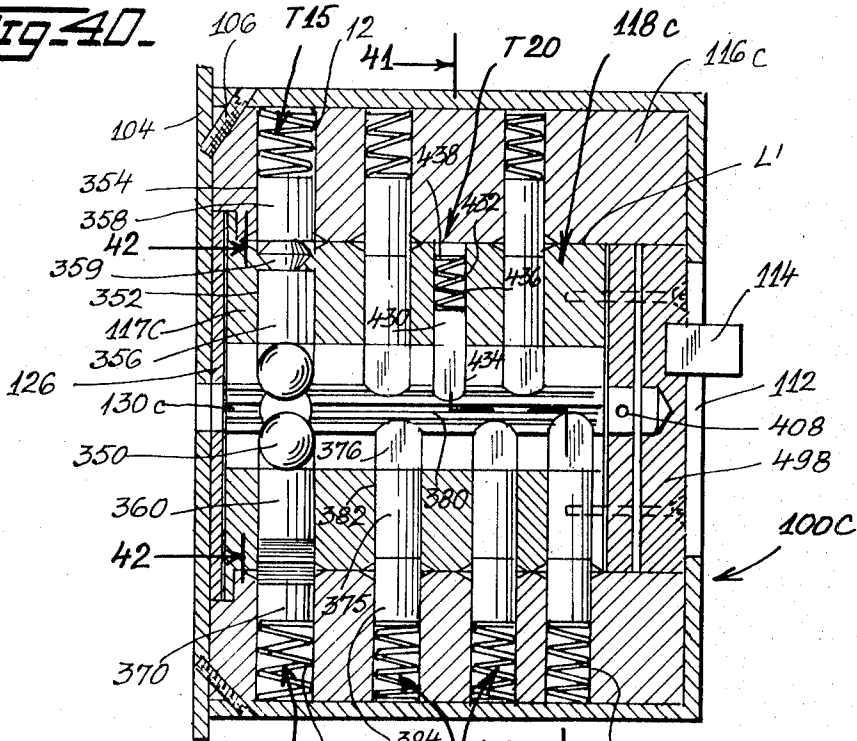


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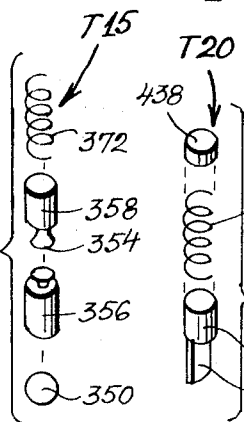


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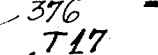


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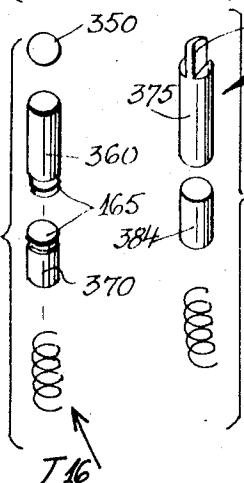


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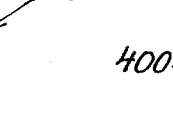


Fig. 47.

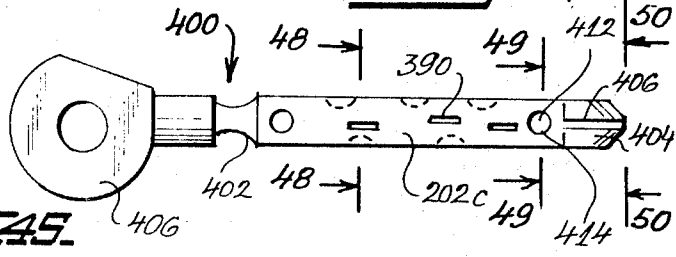


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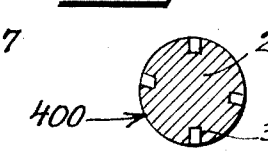


Fig. 49.

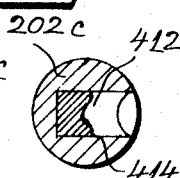
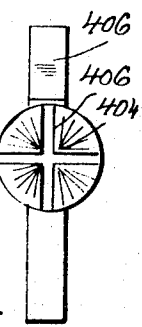


Fig. 50.



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LOCK ASSEMBLY

This invention relates to a pick-resistant lock and key therefor, and more particularly concerns a cylinder lock having features which make it extremely difficult or impossible to pick.

Many innovations have been proposed to render pickproof cylinder locks employing pin tumblers. Generally they have not proven successful because their design was based upon an insufficient understanding of the techniques by which an expert picks a lock.

In picking a lock, an expert will attempt to determine which of the tumbler pins has the tightest fit in the lock. The picker will raise this pin tumbler first. At the same time he applies torque to the key cylinder or plug so that the cylinder rotates sufficiently to present a ledge at the shear line between cylinder and barrel of the lock at the raised pin tumbler, so this pin rests on the ledge. This first pin is thus prevented from reentry into the key cylinder. The lock picker then proceeds to pick the remaining tumbler pins in similar fashion, taking care not to disturb any raised pin.

In all the pick resistant and so-called pickproof locks proposed heretofore, no basic change is made in the arrangement of the tumbler pins themselves. All the tumbler pins have the same sizes and construction and all are axially movable outwardly against spring bias. This facilitates the picking of the lock. Furthermore the rotatable key cylinder is exposed and accessible at the outer face of the lock. This again facilitates picking of the lock. Some locks proposed have a multiplicity of rows of pin tumblers. Such locks are typically described in U.S. Pat. Nos. 3,167,943 and 3,303,677, but these locks suffer the deficiencies mentioned above among others. As a result they only prolong the time required by an expert lock picker to pick the lock.

The present invention is directed at an improved pick resistant or pickproof lock which embodies a multiplicity of features all specifically directed at defeating picking of the lock by conventional methods. According to the invention, a cylinder lock is provided having a round keyhole. The key is cylindrical and has depressions, slots, recesses or dimples formed therein. It has no axially projecting teeth as is conventional in flat keys for cylinder locks. At the front end of the lock cylinder or plug is a flat annular ring which is separate from the lock cylinder; and a stationary cover plate is disposed in front of this protective ring. This prevents applying torque at the outside of the lock cylinder to pick the lock. The lock cylinder may be made in two or more parts which rotate together but in which there may be some circumferential and axial play. This effectively prevents turning the lock cylinder off center for picking. The innermost end part or section of the cylinder is arranged to be engaged by a specially shaped end of the key shaft. The key shaft may be magnetized for pulling magnetic tumbler pins inwardly rather than outwardly. The tumbler pins which operate magnetically are flush with the inside of the keyhole. Attempts to pick the lock by pushing these magnetic pins radially outward defeats picking the lock. No conventional picking tools can pull these magnetic tumbler pins inwardly and hold them stationary precisely at the shear line while other pins are picked. In the lock, some tumbler pins are not magnetically operated, and these are located in random positions axially and circumferentially around the key cylinder, as are the magnetically operated pins. In the lock cylinder, some tumbler pins fit loosely in their holes and stay loose and free at all times to defeat picking of the lock by engaging a picked pin on a ledge of the pin hole at the shear line. Pins may have different diameters to project different distances in the keyhole. Tapered pin drivers or plungers can be provided which also make picking more difficult. Spring means can also be provided to keep the key cylinder under circumferential spring tension which further protects the lock against picking. In magnetic pin tumblers, pins of different diameters are pulled inwardly different axial distances into depression in the key. The depressions and slots in the key shaft have different depths. Some tumbler pins have flat, wafer ends which are not possible to pick by conventional methods

of picking cylindrical tumbler pins. When a lock has a plurality of pickresistant features such as mentioned above, distributed in a random way, it is rendered substantially pickproof.

The above and other features, objects and advantages of the invention will become apparent from the following detailed description taken together with the drawings, wherein:

FIG. 1 is an enlarged longitudinal sectional view of a lock embodying the invention.

FIGS. 2, 3 and 4 are cross sectional views taken on lines 2—2, 3—3 and 4—4 respectively of FIG. 1.

FIG. 5 is a perspective view of an insert in the key cylinder or plug which engages a specially shaped end of a cylindrical key.

FIG. 6 is a side view of a key according to the invention, part being broken away to show a magnetized insert in the key shaft.

FIG. 7 is a cross sectional view taken on line 7—7 of FIG. 6.

FIG. 8 is an enlarged cross sectional view taken on line 8—8 of FIG. 7.

FIG. 9 is a fragmentary longitudinal sectional view similar to an end portion of the lock of FIG. 1, showing structural features of another lock.

FIG. 10 is a perspective view of an insert in the end of the lock cylinder of the lock of FIG. 9.

FIG. 11 is a side view of another key structure according to the invention.

FIG. 12 is an enlarged cross sectional view taken on line 12—12 of FIG. 11.

FIG. 13 is an exploded perspective view of parts of the key of FIG. 11.

FIG. 14 is a sectional view similar to FIG. 12, showing another key structure.

FIG. 15 is an enlarged cross sectional view taken on line 15—15 of FIG. 11.

FIGS. 16—26 inclusive are cross sectional views similar to part of FIG. 15, showing other key structures.

FIG. 27 is a fragmentary longitudinal sectional view similar to a portion of FIG. 1, showing an end portion of another lock.

FIG. 28 is a side view of a key which can be used with the lock of FIG. 27.

FIG. 29 is an exploded perspective view showing the end of the key of FIG. 28 and an insert used in the lock cylinder of FIG. 27.

FIG. 30 and FIG. 31 are cross sectional views taken on lines 30—30 and 31—31 respectively of FIG. 29.

FIGS. 32, 34, 36 and 38 are cross sections similar to FIG. 30 of other cylinder inserts.

FIGS. 33, 35, 37 and 39 are cross sections similar to FIG. 31 of other keys used with the cylinder inserts of FIGS. 32, 34, 36 and 38 respectively.

FIG. 40 is a longitudinal sectional view of another lock.

FIG. 41 is a cross sectional view taken on line 41—41 of FIG. 40.

FIG. 42 is a cross sectional view taken on line 42—42 of FIG. 40, through the rotatable cylinder of the lock.

FIGS. 43, 44, 45 and 46 are exploded perspective views of pin tumbler assemblies employed in the lock of FIG. 40.

FIG. 47 is a side view of a key usable with the lock of FIG. 40.

FIGS. 48 and 49 are cross sectional views and FIG. 50 is an end view on an enlarged scale taken on lines 48—48, 49—49 and 50—50 of FIG. 47.

Referring first to FIGS. 1—4, there is shown a lock assembly 100 comprising an outer cylindrical cup shaped casing 102 having a circular front end face plate 104 secured by screws 106 to annular flange 108 of the casing. The circular rear end 110 of the casing has an opening 112 through which extends an eccentrically disposed bolt or cam 114. Inside the casing is a stationary cylindrical barrel 116. A cylindrical plug or lock cylinder assembly 118 having a main front section 117 and a rear end section 119 is rotatably disposed in bore 120 in the barrel. The junction of the outer side of the lock cylinder and

bore 120 defines a shear line L. Bolt 114 is secured to end section 119 of the cylinder 118.

The front end of the main cylinder section 117 is formed with an annular flange 122 which rotatably abuts a shoulder 124 in the barrel. A flat ring 126 is disposed between the front end of the cylinder and face plate 104. This ring is separate from the cylinder and may be independently rotatable or may be fixed with respect to the face plate. Key holes 128, 129 in the face plate and ring are axially aligned and register with axial bore 130 in cylinder section 117. This bore is cylindrical. Engaged with cylinder section 117 is a plug 132 fitted into a blind hole 136 in section 117 and axially movable in hole 138 in cylinder section 119. A coil spring 140 in hole 138 urges the plug 132 into hole 136. By this arrangement the cylinder section 117 and end section 119 are slightly movable axially and circumferentially with respect to each other while remaining in axial alignment in bore 120 of the barrel 116. This relative movement of the two cylinder parts or sections will forestall any attempt at lock picking since any torque applied to the main cylinder section 117 will not be followed precisely by end section 119.

A cup shaped cylindrical insert 142 is frictionally fitted in bore 144 in cylinder section 119; see FIGS. 1, 2, 4 and 5. The insert is held in place by a lateral key 146. Insert 142 has an axial bore 150 which may have any shape regular or irregular. Bore 150 can receive a suitable shaped end of a key for turning the cylinder assembly 118 as will be described below in connection with FIGS. 6-8.

A plurality of radial bores 154 is formed in barrel 116. These bores are axially aligned with bores 156 in cylinders sections 117 and 119. Assemblies of tumbler pins, pin drivers and springs are disposed in the several bores. The bores are spaced apart axially and circumferentially of the barrel 116 and cylinder 118 in various random ways. Some of the different tumbler arrangements which can be used are shown in FIGS. 1, 2 and 3. Before describing these tumbler assemblies, it will be well to refer first to FIGS. 6 to 8 where key 200 is shown.

The key 200 has a cylindrical shank or shaft 202 at least as long as the bore 130 in cylinder section 117. At the front end of the key is a handle 203 of any convenient shape which can be manually grasped for inserting the key shaft in keyholes 128, 129 and bore 130, and for turning the key. A flattened upper edge 204 can be provided to indicate the proper key position for inserting it in the lock. In key shaft 202 is a multiplicity of recesses, dimples, grooves, and depressions 210 spaced apart axially and circumferentially in random locations all corresponding to similarly located radial bores in the sections 117 and 119 of lock cylinder 118. At the end of the key shaft is a stud 212 having a shape in cross section which corresponds with and fits into bore 150 in cylinder insert 142 for turning the cylinder assembly 118. In some recesses such as recesses 210a and 210b, are fitted strong permanent magnets 214 and 215 which operate magnetic tumbler assemblies in the lock by magnetically drawing their tumbler pins radially inward of the lock into the recesses. Other recesses in the key shaft have different depths and diameters for axially lifting tumbler pins different distances to align pin drivers with the shear line. Some of the different tumbler arrangements which can be used and operated by key 200 will not be explained by referring again to FIGS. 1, 2 and 3.

Tumbler assembly T1 has a freely rotatable ball 160 seated at a constricted end of bore 156a and extending partially into bore 130. A cylindrical pin 162 bears on the ball. A cylindrical pin driver 164 bears on pin 162 just below or inside of the shear line L. Coil spring 166 bears on the cylindrical driver. This tumbler arrangement is very difficult to pick since the rotatable ball allows no stable surface for a picking tool to engage. Furthermore adjacent edges of bores 154a and 156a are countersunk so there is no ledge at the shear line for driver 164 to engage. In addition adjacent ends of the pin and driver have grooves and ridges 165 any one of which can conceivably be engaged at the shear line L, which would give an expert lock picker

a false indication of where the shear line is, since the inner end of the driver 164 would not be located precisely at the shear line. In operation, the ball, pin and driver will be retracted when key shaft 202 is inserted into bore 130. Then the ball will rest in a registering recess in the key shaft. This aligns the tip of driver 174 with shear line L inner end of driver 164 with shear line L. If all other pin drivers in the lock are aligned with shear line L then the cylinder 118 can be turned to turn bolt 114.

Tumbler assembly T2 has a pin 170 made of magnetic material. The inner free end of the pin is flush with the constricted end of bore 156b. A coil spring 172 around the pin tends to retract the pin. Pin driver 174 is also magnetic and is integral with pin 170. This pin driver has a tip of narrow diameter bearing against a cylindrical magnet 174. This magnet is weaker than an operating magnet employed in the key described below. Magnet 174 abuts a cylindrical stop 175 in bore 154b. When the key is properly inserted into the lock, magnet 214 in the key shaft shown in FIG. 7 will align with pin 170 and will draw this pin magnetically into recess 210a. This will align the tip 173 of driver 174 with the shear line L in proper position for turning the cylinder assembly 118. It will be noted that the pin 170 is pulled axially inward to operate this tumbler assembly. When the key is released spring 172 retracts the pin and driver, and tip 173 of the driver assumes a position across the shear line. Magnet 174 cooperates with spring 172 in keeping the free end of pin 170 flush with the surface of bore 130. It will move with driver 174 up to the shear line L and will separate therefrom when the cylinder assembly 118 is turned.

Tumbler assembly T3 has a pin 180 projecting slightly from bore 156c which is narrower than bores 156a and 156b. The pin has a head 182 bearing on a shoulder in bore 156c. Driver 184 has a tip 186 bearing on head 182 and extending out of bore 154c and across the shear line L. Spring 166c bears on driver 184. In operation the pin will initially be retracted as key shaft 202 is moved axially in bore 130. Finally the pin will engage in a recess 210 in the key shaft. The pin will be slightly retracted to locate the tip of the driver at the shear line to permit the cylinder assembly to turn with the key.

Tumbler assembly T4 has a pin 188 which is diametrically wider than pin 180. Pins 180 and 188 each have an end portion extending into the bore 130, these end portions being substantially hemispherical and because of the difference in diameter thereof they extend axially a different distance into bore 130. The head 189 of the pin rests on the shoulder in bore 156d. Cylindrical driver 190 bears on head 189 and extends across the shear line. Spring 166d bears on pin driver 190. This assembly acts like assembly T3 where the end of the pin rests in a recess in the key shaft to align the faces of the cylindrical pin head and pin driver with the shear line L.

Tumbler assembly T5 has a cylindrical pin 192 formed with a conical tip 194 extending partially out of constricted inner end of bore 156e. The upper end of the pin is formed with ridges and grooves as in pin 162 of tumbler assembly T1. Cylindrical driver 194 has ridges and grooves as in pin driver 164. Edges of bores 154e and 156e are countersunk. As explained previously this arrangement makes picking very difficult. Also the conical end of the pin makes it difficult to engage a pick thereon. Spring 166e bears on the pin driver. The conical pin and extends slightly more into bore 130 than pins having ends of larger diameter. The recess into which this pin end will engage will be similarly shaped in the key shaft. The mating faces of the pin driver and pin will be located at the shear line when the key shaft is properly inserted in the lock.

Tumbler assembly T6 has a conical pin 196 which fits snugly into the conical bore 156f. This contrasts with the other radial tumbler pins described which fit loosely in the bores of the cylinder assembly. The lower end of pin driver 198 in bore 154f is also conically tapered. Spring 166f bears on the pin driver. The conical arrangement makes it difficult to pick or impossible to engage and hold this pin driver on the edge of bore 156f which is countersunk. Also the conical pin is difficult to engage with a picking tool. When the key is inserted

the mating faces of pin and driver are located at the shear line L.

Tumbler assembly T7 is magnetically operated. Cylindrical pin 250 fits loosely in bore 156g. Its inner end is flush with the surface of bore 130. Pin 250 is made of magnetic material such as stainless steel. A stationary magnet 252 holds the pin in place. Pin 250 crosses the shear line L. When a magnet such as magnet 215 in the key shaft, shown in FIG. 6 is aligned with pin 250, the pin will be pulled radially inward into the bore 130 to align the outer end of the pin with the shear line L. When the key is removed, magnet 252 retracts the pin again. Magnet 215 will be stronger than magnet 252 to advance the pin against the pull of magnet 252.

Tumbler assembly T8 has a pin 254 formed with a wafer tip 256. Pin 254 is located in radial bore 156h in cylinder section 119. Tip 256 extends through slot 258 in cylindrical insert 142. This wafer tip will engage on recess 260 formed in stud 212 shown in FIG. 6. Driver 262 bears on pin 254 and spring 166h bears on the pin driver. The pin driver extends across shear line L and aligns with the shear line when tip 256 is engaged in key recess 260.

Tumbler assembly T9 has a cylindrical pin 264 loosely fitted in bore 156j. The outer end of the pin is hemispherically shaped with a flat outer face. Pin driver 266 is also hemispherically shaped at the end which bears on pin 264. Spring 166j bears on the pin driver. This arrangement is very difficult to pick. The pin rocks laterally on the curved shoulder 267 in the cylinder section 117 at the outer end of bore 156j. Pin 265 projects slightly into bore 130 and will be retracted by the key shaft. When the free end of the pin rests in a recess in the key shaft, the flat juxtaposed faces of the pin and pin driver will be aligned with the shear line L.

Tumbler assembly T10 is magnetically operated. Pin 270 is magnetic and its free end is flush with the inside of bore 130. The pin 270 and driver 272 are balanced between springs 274 and 166k. The pin will be advanced radially inwardly into bore 130 by a magnet in the key shaft. This will align the juxtaposed ends of the pin and pin driver at the shear line. Tumbler assemblies T11, T12 and T14 are respectively similar to tumbler assemblies T7, T3 and T4 so no further explanation is required.

Tumbler assembly T13 is magnetically operated. Pin 280 has a head 282 crossing shear line L and engaged by fixed magnet 284. The pin is advanced axially inward by a magnet in the key shaft 202 against the tension is spring 286. The magnet 284 cooperates with spring 286 in holding the pin in place with its inner end flush with the inside of bore 130.

FIGS. 1 and 4 show a further arrangement for making it more difficult to pick this lock. Kick springs 293 are set in oblique bores 294 in the barrel. The springs are axially compressed and bear against plugs 295 at outer ends. The springs bear laterally against the cylinder section 117, and resist turning of the cylinder assembly 118. Any slight turning of the cylinder assembly in a picking attempt will be countered by the springs 293 which will tend to return the cylinder assembly to its stable locked position.

In FIG. 9 is shown part of another lock 100A which is generally similar to lock 100 of FIGS. 1-4 and corresponding parts are identically numbered. In lock 100A end section 119a of the cylinder assembly is secured to main cylinder section 117a by screws 298. Cylindrical insert 142a also shown in FIG. 10 has a hexagonal bore 150a to receive a corresponding shaped end of a key such as key 200A of FIG. 11. The insert extends partially into the end of cylinder section 119a. Thus the torque exerted by the key is applied to both sections simultaneously.

Key 200A shown in FIGS. 11, 12, 13 and 15 is formed in several parts. The key has a tubular shaft or shank 202a in which is axially secured magnetized bar or bar magnet 300. The bar magnet is hexagonal in cross section with recesses 302 aligned with holes 303 in shaft 202a. The magnet will draw ends of magnetic pins such as pin 250 into bore 130 for clearing the shear line L. Recess 268a in the exposed end 300a of

bar 300 engages wafer tip 256 of pin 254. Shaft 202a has an integral handle 203a.

FIG. 14 shows a section of another key 200B which is similar to key 200A except that the inserted bar 300' is not magnetized. Instead cylindrical magnets 304 are inserted in recesses 306 in the bar for attracting the magnetic pins of magnetically operated tumbler assemblies such as described above.

FIGS. 16 through 26 show other keys 200B-200L each of which has a differently shaped key end 300b-300m. Some key ends such as key ends 300b and 300c can have regular geometrical shapes such as triangular or square with ridges 308, 310 along the sides. The key ends can have other regular polygonal shapes. Key ends 300d, 300e and 300f are respectively pentagonal, parallelogrammic, and octagonal. Still other shapes are possible. Key ends 300g and 300h are parts of circles. Key ends 300i, and 300k are crosses. Key end 300j is circular with V-shaped notches 312 at opposite sides. Key end 300m is circular with a groove 314 at one side. Other geometrical shapes can be provided. The cylindrical inserts in the end sections of the lock cylinders will have correspondingly shaped bores.

FIG. 27 shows part of a lock 100B which is generally similar to lock 100 and corresponding parts are identically numbered. This lock has a cylindrical insert 142b provided with a transversely extending wire or pin 320. As shown in FIG. 29 this insert receives end 333 of cylindrical key shaft 202b. A diametral slot 355 is formed in the cylindrical end of the shaft. The bore 150b in the insert is cylindrical. It is of course possible to provide polygonal shaped key ends such as shown in FIGS. 8 and 15-20, and to form slots therein for engaging transverse pins inserted in the corresponding lock inserts. In any case the slotted end 333 of key 200N shown in FIGS. 28, 29 and 31 will engage with the transverse pin or wire 320 of insert 142b shown in FIGS. 27, 29 and 30. Thus when the tumbler assemblies are all properly aligned with the shear line L of the lock, turning of key 200N will rotate the cylinder assembly 118. Notch or recess 268 in the key end receives and engages wafer end 256 of pin 254.

FIGS. 32, 34, 36 and 38 show other lock inserts 142c-142f. These have two pins 340-343 which may be parallel, crossed or angular to each other. Keys with correspondingly slotted ends are shown in FIGS. 33, 35, 37 and 39. Key end 333a has two parallel slots 335a. Key ends 333b and 333c have crossed slots 335b, 335c and key end 333d has angularly disposed slots 333d. Other arrangements of pins and slots can be provided.

Lock 100C shown in FIGS. 41 and 41 is generally similar to the lock previously described and corresponding parts are identically numbered. In lock 100C, a plurality of tumbler assemblies are provided near the front end of the lock. Each of these assemblies has a ball 350 protruding into axial bore 130c; see FIGS. 40 and 42. The main cylinder section 117c is formed with a plurality of radial bores 352 aligned axially with radial bores 354 in barrel 116c. These balls serve as obstructions to entry of picks into the bore 130c of the lock. FIG. 43 shows parts of tumbler assembly T15 which includes a pin 356 and driver 358 having conical abutted ends 359 of reduced diameter. Parts of tumbler assembly T16 shown in FIG. 44 include cylindrical pin 360 and driver 370. Ridges and grooves 165 are formed in adjacent ends. Edges of bores 352 and 354 at the shear line L' are countersunk. Springs 372 urge the pins, drivers and balls radially inward of the lock cylinder. This arrangement is very difficult to pick successfully.

Other tumbler assemblies T17 have pins 375 formed with flat wafer tips 376; see FIG. 46. The main cylinder section 117c is formed with longitudinally extending radial slots 380 in which these flat wafer tips or ends are slidably fitted. Ends of the tips extend into bore 130c. Pins 375 slide in radial bores 382 in cylinder section 117c. Pin drivers 384 slide in bores 386 in the barrel. Springs 388 urge the pins and pin drivers radially inwardly.

All these flat wafer tips or ends 376 will be engaged in slots 390 formed in cylindrical shaft 202c of key 400 shown in FIGS. 47-50 to which reference is now made.

The key shaft 202c has a circumferential groove 402 to receive and engage balls 350 so that pin drivers 358 and 370 are retracted to the shear line L'. Handle 406 is disposed adjacent to groove 402. At the free pointed end 404 of the shaft are crossed slots 406 similar to the arrangement of FIG. 37 for engaging crossed wires or pins 408 extending diametrically through cylinder end section 119c clearly shown in FIG. 40. Insert magnets 412 are inserted in holes 414 in the key shaft. These magnets attract magnetic pins such as pin 418 of tumbler assembly T18 shown in FIG. 41. There the head 419 of the pin is normally held by coil spring 420 and magnet 422 in aligned bores 424, 426, with head 419 extending across the shear line L'.

It will be noted that the cross wires 408 bear the strain of turning the cylinder assembly 118c and bolt 114. To relieve this strain somewhat, an auxiliary tumbler assembly T20 shown in FIGS. 40, 41 and 45 is provided. Pin 430 is axially movable in a radial bore 432 formed in cylinder section 117c. The pin has a wafer tip 434 extending through a slot 380 into bore 130c for engagement in a slot 390 in the key shaft. Spring 436 bears on the pin and against an abutment disc 438 which slides around the inside of barrel 116c when the cylinder assembly 118c is turned. By this arrangement, the engagement of pin 430 with the key shaft 202c serves to turn the cylinder assembly with the turning key shaft. It will be noted that the wafer tip 434 projects into bore 130c much further than the other wafer tips 376, and serves a primary function of engaging the key to turn the shaft assembly, while the wafer tips 376 primarily serve to align the pins and pin drivers with the shear line L'.

All the locks and lock features described serve in one way or another to make picking of the lock more difficult. When a lock has a plurality of anti-picking features embodied therein, picking becomes so difficult that for all practical purposes, the lock is rendered pickproof. Not all the features described, obviously, can be incorporated in every lock. A judicious selection is required, depending on security requirements, cost, size, and similar considerations.

While a limited number of embodiments of the invention has been described it will be understood that this has only been by way of illustration, since other modifications will readily occur to those skilled in the art.

What is claimed is:

1. A lock assembly, comprising a barrel having a first bore therein; a cylinder rotatably disposed in said bore to define a shear line therewith, said cylinder having an axial second bore for receiving the shaft of a key inserted through one end of said second bore; key engaging means at the other end of said second bore; a plurality of spaced apart tumbler pin assemblies, said cylinder and said barrel having aligned radial bores respectively containing said tumbler assemblies, each of said tumbler assemblies comprising a pin engageable in a recess in said key shaft with a part of the tumbler assembly normally disposed across the shear line, each tumbler assembly being arranged so that said part of the tumbler assembly clears the shear line when the pin is engaged in said recess to permit turning of the cylinder by the key, said cylinder comprising two axially aligned cylindrical sections; spring biased means loosely connecting the two cylindrical sections and arranged to permit slight relative radial and axial and circumferential movement against axially directed spring bias between the two sections; said barrel having other bores therein extending tangentially of one of the cylindrical sections at opposite sides thereof; and coiled kick springs in said other bores bearing laterally against said one cylindrical section, and opposing slight circumferential movements of said one cylindrical section in said first bore to forestall picking of the tumbler assemblies.

2. A lock assembly as defined in claim 1, wherein said radial bores and tumbler assemblies are spaced apart circumferentially and axially of said cylinder.

3. A lock assembly as defined in claim 2, wherein at least one of the tumbler assemblies has a pin extending into said second bore for lifting by said key shaft a predetermine radial distance when the key is inserted into the second bore.

4. A lock assembly as defined in claim 2, wherein at least one other of said tumbler assemblies has another pin with a free inner end disposed flush with the inside of said second bore, said other pin being made of magnetic material for magnetic attraction by said key shaft to move said other pin radially into said second bore, so that a part of said other tumbler assembly clears said shear line.

5. A lock assembly as defined in claim 1, wherein at least one of said tumbler assemblies has a tapered pin fitting snugly in a tapered radial bore in said cylinder.

6. A lock assembly as defined in claim 1, wherein at least one of said tumbler assemblies has a pin formed with a flat wafer edge to engage in a slot in the key shaft.

7. A lock assembly as defined in claim 1, wherein the pins of some tumbler assemblies have different diameters and project different distances into said axial second bore.

8. A lock assembly as defined in claim 1, further comprising at least one annular plate member disposed at and covering one end of said cylinder and independently rotatable to prevent engagement of said one end of the cylinder and thus prevent picking of the lock.

9. A lock assembly as defined in claim 1, further comprising a key having a cylindrical key shaft formed with a plurality of recesses circumferentially and axially spaced around the shaft to correspond with the spacing of said tumbler assemblies for receiving respective pins thereof.

10. A lock assembly as defined in claim 9, wherein said shaft has a free end shaped to engage with said key engaging means at the other end of said second bore, said free end of the shaft having a tapered tip to facilitate entry of the shaft into said second bore to lift pins projecting therein.

11. A lock assembly as defined in claim 10, wherein both said free end of the key shaft and said key engaging means are noncircular in cross section.

12. A lock assembly as defined in claim 10, wherein said free end of the key shaft has at least one slot therein, and wherein said key engaging means comprises at least one cross pin engageable in said slot in the key shaft.

13. A lock assembly as defined in claim 9, wherein said key shaft is magnetized at least in part, and wherein at least one other of said tumbler assemblies has another pin with a free inner end disposed flush with the inside of said second bore, said other pin being made of magnetic material for magnetic attraction by said key shaft to move said other pin radially into said second bore, so that a part of said other tumbler assembly clears said shear line.

14. A lock assembly as defined in claim 1, wherein at least some of said radial bores have countersunk ends at said shear line to forestall picking of the tumbler assemblies thereat.

15. A lock assembly as defined in claim 1, wherein at least some of the tumbler assemblies each comprises a pin driver juxtaposed to an inner end of pin; and a coil spring bearing on the pin driver.

16. A lock assembly as defined in claim 4, wherein said other tumbler assembly includes a coil spring arranged to retract said other pin when the key shaft is removed from said other bore.

17. A lock assembly as defined in claim 16, wherein said other tumbler assembly comprises a magnet for cooperating with said spring in holding said other pin with inner end flush with said second bore.

18. A lock assembly as defined in claim 14, wherein at least one of the tumbler assemblies includes a pin driver, both said pin and pin driver having ridged and grooved abutted edge portions near the shear line to forestall picking of the tumbler assembly.

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