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LOCKING APPARATUS
FIELD OF THE INVENTION

The present invention relates to locking apparatus generally and more particularly to key blanks, keys, and locks actuated thereby.

BACKGROUND OF THE INVENTION

A great variety of key blanks and associated locks are known. In the prior art, key blanks include a generally elongate unitary key cut-bearing portion with which is associated a key head. Various types of cylinder locks are also known.

Relevant patents include U.S. Patent 4,377,082; 5,123,268; 3,287,945; French Patents 82.01.905 and 84.03.944 and PCT published application 84.400.694.0.

SUMMARY OF THE INVENTION

The present invention seeks to provide an improved key blank, key and lock.

There is thus provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element being displaceable in a single direction, outwardly from the key combination surface.

There is also provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft portion defining a key combination

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surface adapted to have formed thereon at a subsequent time, a plurality of key cuts arranged in a row, which key cuts define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element arranged to lie along each row of key cuts.

There is additionally provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element being selectably configurable to provide multiple combinations.

In accordance with one embodiment of the present invention, the movable insert element is configurable prior to its insertion in the key blank.

In accordance with another preferred embodiment of the present invention, the movable insert element may be configurable following its insertion in the key blank. Preferably the configuration of the movable insert element can be carried out using the same key cutting apparatus used for cutting the remaining key cuts on the key blank.

The key blank may also comprise a retractable cover member for covering part of the shaft including the movable insert element, when it is not inserted in a lock keyway.

Preferably, the key blank is a reversible key blank arranged to have formed thereon a pair of opposite key combination surfaces and includes a pair of movable insert



elements, each associated with one of the key combination surfaces.

In accordance with a preferred embodiment of the invention one or more movable insert elements may be provided having the same or different configurations. In such a case, depending on the orientation of the key it is operative to operate two different and mutually exclusive master key systems.

Additionally in accordance with a preferred embodiment of the present invention there is provided a lock cylinder configured to be operated by a key of any of the types described hereinabove, the lock comprising:

- a housing;

- a plug disposed in the housing, arranged for rotation relative thereto and defining a keyway;

- a first plurality of chambers formed in the housing and a second plurality of chambers formed in the plug on one side of the keyway and being arranged such that each one of the first plurality of chambers extends coaxially with a corresponding one of the second plurality of chambers, when the plug is in a first rotational orientation relative to the housing;

- first pin assemblies being disposed in the first plurality of chambers and second pin assemblies being disposed in the second plurality of chambers;

- a third pin assembly being disposed in the plug on a side of the keyway opposite to that of the second pin assemblies and being operative to urge said movable insert element outwardly into engagement with one of the second pin assemblies.



The lock cylinder may ⁴ be employed in any suitable kind of lock, such as a door lock, a padlock or a gear-shift lock.

In accordance with a preferred embodiment of the present invention, the movable insert element is formed with a recess on its surface facing in the same direction as the key combination surface.

Additionally in accordance with a preferred embodiment of the present invention, the movable insert element may operate with telescopic plug pins.

The present invention also seeks to provide an improved cylinder lock which overcomes the limitations of the prior art.

There is thus provided in accordance with a preferred embodiment of the present invention a cylinder lock including a lock shell having a cylindrical bore formed therein, a plug arranged for rotation within the cylindrical bore, the plug having a plurality of annular grooves formed on an outer surface thereof, the plug being formed with a keyway communicating with the outer surface; a hive, including a plurality of pin assemblies therein and being arranged for operative engagement with a corresponding plurality of plug pin assemblies located within the plug and a key having a plurality of exterior surfaces, one of which being an edge surface which communicates with the outer surface of the plug, the cylinder lock being characterized in that the hive includes at least one protrusion which is arranged in juxtaposition with at least one of the plurality of annular grooves and the key is formed with at least one groove at its edge surface corresponding to the at least one protrusion.

In accordance with a preferred embodiment of the



present invention, the key is formed with pin positioning recesses on one of the exterior surfaces lying perpendicular to the edge surface thereof.

Further in accordance with a preferred embodiment of the present invention, there is provided a key blank having an elongate shaft portion including a pair of side surfaces arranged to receive pin positioning recesses and a pair of edge surfaces, at least one of which is formed with at least one groove extending thereacross in a direction perpendicular to the longitudinal axis of the elongate shaft portion.

Additionally, in accordance with a preferred embodiment of the present invention, there may be provided additional protrusion bearing members associated with the lock shell and having protrusions extending into one or more of the annular grooves on the plug.

In accordance with a further embodiment of the invention, there is provided a cylinder lock including a lock shell having a bore formed therein, a bore lining element disposed in the bore and defining an inner bore having at least one annular protrusion therein, a plug arranged for rotation within the inner bore, the plug having at least one annular groove formed on an outer surface thereof, the plug being formed with a keyway communicating with the outer surface; a hive, including a plurality of pin assemblies therein and being arranged for operative engagement with a corresponding plurality of plug pin assemblies located within the plug and a key having a plurality of exterior surfaces, one of which being an edge surface which communicates



with the outer surface of the plug, the cylinder lock being characterized in that the key is formed with at least one groove at its edge surface corresponding to the at least one protrusion.

It is appreciated that the cylinder lock of the present invention may be employed in any suitable application, such as door locks, padlocks and the like and may appear in any suitable configuration.

It is a particular feature of the present invention that the ward is retained in place by the body pins which prevent removal of the ward even when a correct key is inserted into the keyway. The only practical way to remove the ward is by removing the pin and spring assemblies.

The structure of the present invention enables the ward, which may be made of hardened metal, to provide additional protection to the body pins and to the shear line defined between the plug and the ward.

Additionally in accordance with a preferred embodiment of the present invention, the protrusions formed on the ward act to prevent the operation of the well-known technique of inserting shims between the plug and the lock shell.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Figs. 1A and 1B are pictorial illustrations showing two types of locks and keys;

Figs. 2A and 2B are pictorial illustrations of a key blank and a key, respectively;



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Figs. 3A, 3B, 3C and 3D are sectional illustrations taken along lines III - III of Fig. 2B, and illustrating four different examples of the construction and mounting of movable insert elements in a key;

Fig. 4 is a sectional illustration of a lock cylinder having a key inserted therein;

Fig. 5 is a partially cut-away pictorial illustration of part of the plug of the lock of Fig. 4, taken along lines V - V of Fig. 4;

Fig. 6 is a planar illustration of the keyway of the plug of Fig. 5, taken along the line VI in Fig. 5;

Figs. 7A and 7B are partially cut away sectional illustrations of the operation of two differently configured movable inserts in engagement with telescoping plug pins;

Figs. 8A and 8B are pictorial illustrations of a key blank and a key;

Fig. 9 is an illustration of a disassembled non-rotatable movable insert assembly particularly useful for configuration with conventional key cutting devices;

Fig. 10 is a sectional illustration of the assembly of Fig. 9 taken along the lines X - X in Fig. 9;

Fig. 11 is an illustration of a disassembled non-rotatable movable insert assembly particularly useful for insert configuration with key cutting apparatus;

Fig. 12 is a sectional illustration of the assembly of Fig. 11 taken along the lines XII - XII in Fig. 11;

Figs. 13, 14 and 15 are illustrations of three differ-

ent non-rotatable insert configurations;⁸

Fig. 16 is a pictorial illustration of a cylinder lock;

Fig. 17 is an exploded view illustration of the cylinder lock of Fig. 16;

Fig. 18 is a pictorial illustration of another cylinder lock;

Fig. 19 is an exploded view illustration of the cylinder lock of Fig. 18;

Fig. 20 is a sectional illustration taken along the lines XX - XX of Fig. 16;

Fig. 21 is a sectional illustration taken along the lines XXI - XXI of Fig. 18;

Fig. 22 is an illustration of a double sided key blank useful with the apparatus of Figs. 16 - 21;

Figs. 23A and 23B are respective perpendicular sectional illustrations of a padlock, Fig. 23B, being taken along the lines B - B in Fig. 23A;

Fig. 24 is an illustration of the engagement of the key, plug, hive and pins in the lock of Figs. 23A and 23B;

Fig. 25 is an exploded view illustration corresponding to Fig. 24; and

Fig. 26 is a pictorial illustration of the key in the padlock of Figs. 23A - 25.

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DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is now made to Figs. 1A and 1B which illustrate a key and cylinder lock constructed and operative in accordance with a preferred embodiment of the present invention. Fig. 1A illustrates a door lock 10 employing a cylinder 12 and key 14 according to the present invention, and Fig. 1B illustrates a padlock 16 employing a cylinder 18 and key 20 according to the present invention.

Broadly speaking, the key and the key blank used to produce the key are characterized in that they include at least one and preferably two movable insert elements having at least one of the following characteristics:

The insert element is arranged for movement in a single direction perpendicular to the plane of the key and the lock keyway.

The insert element is non-rotatable with respect to the remainder of the key.

The insert element is selectably configurable so as to define a plurality of different permutations.

The insert element includes a recess.

The insert element is arranged to lie along a row of key cuts conventionally formed in the key and thus operates a conventional plug pin of the lock.

A pair of insert elements having different configurations are associated with opposite key combination surfaces, thus providing a double function key and key blank.

These and other features of the key blank, key and lock of the present invention will be described hereinbelow with

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reference to the remainder of the drawings in order to provide a comprehensive picture of the novel features of the invention which is applicable to any suitable cylinder lock context.

Reference is now made to Figs. 2A and 2B which illustrate a key blank 22 and key 24 constructed and operative in accordance with a preferred embodiment of the present invention. The common features of the key blank 22 and the key 24 will now be described using identical reference indications.

Both the key blank 22 and the key 24 comprise a generally elongate shaft portion 26, preferably, but not necessarily including first and second opposite planar surfaces 28 and 30, at least one of which constitutes a key combination surface 30 which is arranged to have formed thereon a plurality of key cuts 32, which define a lock combination in a conventional manner. When the key blank 22 and the key 24 define reversible keys, both of planar surfaces 28 and 30 constitute key combination surfaces.

Preferably, each key combination surface 30 also defines elongate keyway guides 34, which fit in configuration to protrusions defined in the interior of the keyway in the corresponding lock, which will be described hereinbelow. Some or all of key cuts 32 may be formed over guides 34.

In accordance with a preferred embodiment of the present invention a movable insert element 40 is retained in shaft portion 26 for motion, preferably in a single direction only, perpendicular to, i.e. in and out of the key combination surface 30. In reversible key blanks, as shown in Figs. 2A and

2B, a pair of oppositely directed movable insert elements 40 are retained in shaft portion 26, each for operative association with a key combination surface.

In accordance with a preferred embodiment of the invention the pair of oppositely-directed movable insert elements may have different configurations and positions. More than two movable insert elements may be provided with the same or different configurations and positions along the blank. In such a case, depending on the orientation of the key it is operative to operate two different and mutually exclusive master key systems, each of which is operated by a different insert element configuration.

Reference is now made to Figs. 3A - 3D which are taken along the lines III - III in Fig. 2B and illustrate four different examples of movable insert mountings and configurations.

In the embodiment of Fig. 3A, the shaft 26 is formed with a two step bore 42 for each insert element 41 and the insert element 41 is preferably integrally formed with a plug pin engaging portion 44 having a facing end 46 which can be selectably configured to provide various combinations, preferably a socket 48 of a desired depth; a broadened intermediate portion 50 and a narrowed pusher pin engagement portion 52. A retaining ring 54 preferably retains the insert element 41 against disengagement from the shaft portion 26 in one direction and engagement of intermediate portion 50 with a shoulder 56 retains the insert element 41 against disengagement from shaft portion 26 in the other direction.

In the embodiment of Fig. 3B the same insert element 41

as in the embodiment of Fig. 3A may be employed. Here, however, a single shoulder bore 60 is provided, having a peripheral recess 62, which accommodates a narrow peripheral protrusion 64 of a swaged retaining ring 66. Here also the two insert elements 41 are differently configured, so as to enable the key to be useful for two different locks depending on the orientation of the key in the keyway.

In the embodiment of Fig. 3C, a different type of insert element 70 is shown and is preferably integrally formed with a plug pin engaging portion 74 having a facing end 76 which can be selectably configured to provide various combinations, preferably a socket 78 of a desired depth and a broadened portion 80 defining a pusher pin engagement surface 82. A retaining ring 84 is partially seated in a peripheral key cut 86 formed in portion 74 adjacent end 76 and preferably retains the insert element 70 against disengagement from the shaft portion 87 in one direction and engagement of a shoulder between portions 74 and 80 of insert element 70 with a corresponding shoulder 88 in a bore retains the insert element 70 against disengagement from shaft portion 87 in the other direction. Bore 90 also defines a broadened portion which accommodates retaining ring 84.

In the embodiment of Fig. 3D, yet another type of insert element 100 is shown and is preferably integrally formed with a plug pin engaging portion 101 having a facing end 102 which can be selectably configured to provide various combinations, preferably a socket 104 of a desired depth, and a broadened portion 106 defining a pusher pin engagement surface

108. No retaining ring is required¹³ inasmuch as the top of a bore 110 is swaged as indicated at reference numeral 112 to retain the insert element 100 against disengagement from the shaft portion 114 in one direction. Engagement of a shoulder between portions 101 and 106 of insert element 100 with a corresponding shoulder 116 in bore 110 retains the insert element 100 against disengagement from shaft portion 114 in the other direction.

Reference is now made to Figs. 4, 5 and 6, which illustrate a lock cylinder in operative engagement with a key constructed in accordance with a preferred embodiment of the present invention. It is to be appreciated that although the key illustrated at reference numeral 120 in Fig. 4 is the embodiment shown in Fig. 3A, any suitable embodiment of key may be employed.

The lock cylinder of Figs. 4, 5 and 6 comprises a housing 122 and a plug 124 which is arranged for rotation relative thereto and defining a keyway 126.

A first plurality of chambers 128 are formed in the housing 122 and a second plurality of chambers 130 are formed in the plug on one side of the keyway and are arranged such that each one of the first plurality of chambers 128 extends coaxially with a corresponding one of the second plurality of chambers 130, when the plug is in a first rotational orientation relative to the housing, as shown in Fig. 4.

A plurality of first pin assemblies 132, which are preferably telescopic pin assemblies having a plurality of concentric pin portions as shown including a spring 131, are preferably disposed in the first plurality of chambers 128 and are retained therein by plugs 134. A plurality of second pin

assemblies 136, which are preferably telescopic pin assemblies having a plurality of concentric pin portions as shown, are disposed in the second plurality of chambers 130. A shear line 138 is defined between the facing surfaces of the respective pluralities of first and second pin assemblies 132 and 136, when the proper key is located in its proper location in the keyway 126 in engagement with the second pin assemblies.

In accordance with a preferred embodiment of the present invention a third pin assembly 140 is disposed in a suitable single shoulder bore 142 in the plug 124 on a side of the keyway 126 opposite to that of the second pin assemblies 130 and is operative to urge a movable insert element 150 outwardly from the key combination surface 152 of the key 120 into operative engagement with one of the second pin assemblies 130. Alternatively, the movable insert element 150 may operate against an additional pin assembly which is not normally found in conventional cylinders.

In the illustrated embodiment, the movable insert element 150 may be identical to insert element 41 in the embodiment of Fig. 3A. The third pin assembly 140 preferably includes a pusher pin 154 having a rounded forward surface 156 and a broadened end portion 158, which is retained against disengagement from plug 124 by a retaining ring 160. A spring 162, which is stronger than the spring 131 of pin assembly 132, urges pusher pin 154 forwardly into displacing engagement with portion 52 of insert element 150, thus urging insert element 41 into operative engagement with one of the second pin assemblies

130, as shown.

Key guide protrusions 164 are illustrated in Figs. 5 and 6.

Fig. 4 illustrates insert 41 having a socket 48 formed at surface 46 thereof. Figs. 7A and 7B illustrate other possible configurations of the forward surface 46 of insert 41, which enable various lock combinations to be realized thereby. In Fig. 7A, the forward surface is flat, as indicated by reference numeral 170. In Fig. 7B, the forward surface 172 is a combination recess and central protrusion. It is appreciated that any other suitable surface configuration may be provided.

Reference is now made to Figs. 8A and 8B which illustrate an alternative embodiment of the key blank and key of Figs. 2A and 2B wherein the movable inserts 180 are located beyond the normal key cuts 182 and keyway engaging guides 184. In such a case, an additional plug pin and housing pin (not shown) must be provided for being operated by the movable insert.

It is a particular feature of the present invention that the configuration of the plug pin engagement surface of the movable insert may be selectably configured either as part of the manufacture of the key blank, or thereafter, when the key cuts are being made. In the latter case, the same machinery used for cutting the remaining key cuts can be employed for configuring the plug pin engagement surface of the movable insert element. This is made possible by impeding rotation of the movable insert, as is illustrated in Figs. 9 - 15.

Reference is now made to Figs. 9 - 15 which illustrate the construction and mounting of a non-rotatable movable insert

element in a key blank. As seen in Figs. 9 and 10, a movable insert element 200 may be generally identical to insert element 41 of Fig. 3A with the additional provision of a radially extending protrusion 202 which seats in a corresponding recess 204 in a bore 206 formed in the key blank shaft 208. The movable plug may be retained, similarly to the embodiment of Fig. 3A, by a retaining ring 210 in press-fit engagement with a portion of bore 206.

According to an alternative embodiment of the present invention, as seen in Figs. 11 and 12, a movable insert element 220 may be generally identical to insert element 41 of Fig. 3A with the additional provision of one or more radially extending recesses 222. The movable plug is retained against rotation by a retaining ring 230, which is formed with protrusions 224 which corresponding to and seat in recesses 222, which is held in non-rotatable press-fit engagement with a portion of a bore 232 in a key blank shaft 234.

Figs. 13, 14 and 15 illustrate three additional illustrative examples of non-rotating movable insert elements, indicated by reference numerals 240, 242 and 244 which may be retained in a corresponding suitably shaped bore 250, 252 and 254 in corresponding key blank shaft portions 260, 262 and 264. The insert elements of Figs. 13 - 15 are typically retained against disengagement by swaging of the respective bores.

It is to be appreciated that any suitable type of non-rotating movable insert elements may be employed. Their configuration and mounting is not limited by the examples

provided herein.

Reference is now made to Figs. 16, 17 and 20 which illustrate a cylinder lock constructed and operative in accordance with a preferred embodiment of the present invention. The cylinder lock, which may be a single cylinder or a double cylinder, as shown, of any suitable configuration comprises a lock shell 310 having at least one elongate generally cylindrical bore 312.

In accordance with a preferred embodiment of the present invention, there is disposed in bore 312 a plug 314 which is arranged for rotation about the longitudinal axis 316 of bore 312 and which is formed with a plurality of annular grooves 318 on an outer surface 320 thereof, the grooves 318 extending generally in planes perpendicular to longitudinal axis 316.

Disposed in lock shell 310 is a hive element 322, which is referred to herein generally as a hive, which contains a plurality of pin and spring assemblies 324 which may be of entirely conventional construction or may be telescopic, as shown in applicant's U.S. Patent 5,123,268. Hive 322 is formed with a surface 326 which effectively forms part of the inner facing surface of bore 312. This surface is formed with bores 328 through which respective body pins 330 and plug pins 332, which form part of pin and spring assemblies 324, extend.

In accordance with a preferred embodiment of the present invention, surface 326 is formed with one or more protrusions 334 which are configured and located such that they lie in one or more of annular grooves 318 of plug 314. Protrusions 334 are preferably in the form of grooved protrusions which extend

along the entire cylindrical extent of surface 326 as shown in Fig. 17, but they need not necessarily be so configured.

Normally, as in the illustrated embodiment of Fig. 17, the hive element 322 is separate from the remainder of the hive in which the pin and spring assemblies 324 are located. Alternatively, the entire hive may be formed as a single piece.

Additionally in accordance with a preferred embodiment of the invention, one or more inserts 340 are additionally provided, having corresponding edge surfaces 342, which effectively form part of the inner facing surface of bore 312. These inserts may also be provided with one or more protrusions 344 which are configured and located so as to lie within annular grooves 318. Inserts 340 may be retained in slots 346 formed in the lock shell 310.

It is a particular feature of the present invention that the provision of protrusions 334 on hive 322 requires that the key blank used to form a key suitable for use with the cylinder should be configured to have corresponding grooved recesses thereon. Since such grooved recesses cannot be formed by conventional key cutting apparatus, they must be present in the key blank produced by a manufacturer.

This arrangement allows the manufacturer the possibility of controlling a relatively large number of different key blank configurations. The provision of multiple elements having inner facing protrusions communicating with the interior of bore enables key mastering to be carried out in a convenient manner. It also can be used to limit angular rotation of the key.

Reference is now made to Figs. 18, 19 and 21 which illustrate a cylinder lock constructed and operative in accordance with an alternative embodiment of the present invention. The cylinder lock, which may be a single cylinder or a double cylinder, as shown, of any suitable configuration comprises a lock shell 380 having at least one elongate generally cylindrical bore 382.

In accordance with a preferred embodiment of the present invention, there is disposed in bore 382 a plug assembly 384 which includes a plurality of bore liner elements 385 and a plug 386, which is arranged for rotation about the longitudinal axis 387 of bore 382, and which is formed with a plurality of annular grooves 388 on an outer surface 390 thereof, the grooves 388 extending generally in planes perpendicular to longitudinal axis 387.

As seen in Fig. 19, parts of the bore liner elements 385 define a hive element 392, which contains a plurality of bores 398, through which extend body pins 400 and 402 which form part of pin and spring assemblies 394 which may be of entirely conventional construction or may be telescopic, as shown in applicant's U.S. Patent 5,123,268. Bore liner elements 385 and thus hive 392 is formed with an inner surface 389 which effectively forms part of the inner facing surface of bore 382.

In accordance with a preferred embodiment of the present invention, surface 389 is formed with one or more protrusions 394 which are configured and located such that they lie in one or more of annular grooves 388 of plug 386. Protrusions 394 are preferably in the form of grooved protrusions which extend

along the entire cylindrical extent of surface 389 as shown in Fig. 19, but they need not necessarily be so configured.

The cooperation between the apparatus illustrated in Fig. 19 and a key 396 inserted into the keyway 395 of bore 386 is illustrated in Fig. 21. Fig. 22 illustrates a preferred key blank for a wherein different key blank groove arrangements 399 on the two edges of key 396 can clearly be seen in addition to conventional pin engaging recesses 397 on the larger surfaces of the key blank, which lie perpendicular to the edges thereof. This arrangement can be useful when a single key can be used for opening two different locks, depending on the orientation of the key in the keyway. Alternatively, identical key blank groove arrangements may be provided on both sides, as for a reversible key.

Reference is now made to Figs. 23A and 23B, which illustrate a cylinder lock of the type described hereinabove in the context of a padlock. Here the plug is indicated by reference numeral 420 and the hive by reference numeral 422. It is seen that the hive 422 has a plug facing surface 424 which is formed with a plurality of protrusions which are configured and located so as to be accommodated by one or more of a plurality of grooves 426 formed on plug 420. A key 430 is formed with edge grooves corresponding to the protrusions 458 on plug facing surface 424 of hive 422.

The lock and key arrangement of the present invention may be used for other types of locks as well.

Reference is now made to Figs. 24 - 26, which

illustrate the interaction of a key 430, with a plug 420, and hive 422 in accordance with a preferred embodiment of the invention. In the illustrated embodiment, the cylindrical surface 424 of the hive 422 is formed with a total of three protrusions 458, which are configured and located to lie within three of the five corresponding annular grooved recesses 426 in plug 420. An edge surface 462 of key 430 is formed with grooved recesses 464 which correspond in location and sectional configuration to protrusions 458, such that rotation of the plug 420 with the key 430 fully inserted into the keyway thereof, as indicated by arrows 466, past protrusions 458 is permitted.

It is particularly noted that in accordance with a preferred embodiment of the present invention, the plug pins 468 in hive 422 engage conventional recesses 470 formed on a side surface of the key 430, which lies perpendicular to the edge surface 462 of the key. It is noted that where a reversible key is provided, as shown in Fig. 26, grooved recesses 464 are provided on both edge surfaces of the key blank.

It is additionally noted that grooved recesses 464 are formed with a generally uniform cross section lying in planes perpendicular to edge surface 462.

It is appreciated that normally there will be a lesser number of protrusions 458 than annular groove recesses 426, such that a large number of different key blanks may be produced to correspond to the large number of combinations of different numbers and locations of protrusions 458.

It will be appreciated that a key blank, a key and a lock operated thereby which combines any of the above-described

features, and particularly any of the features shown in Figs. 1 - 15 with any of the features in Figs. 16 - 26 is also within the scope of the present invention.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

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1. A key blank comprising:

a generally elongate shaft portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination; and

at least one movable insert element retained within the elongate shaft portion, the movable insert element being displaceable in a single direction, outwardly from the key combination surface, said at least one movable insert element being selectably configurable to provide multiple combinations.

2. A key blank according to claim 1 and wherein the key blank is a reversible key blank arranged to have formed thereon a pair of opposite key combination surfaces and includes at least two movable insert elements, each associated with one of the key combination surfaces.

3. A key blank according to claim 2 and wherein at least two movable insert elements have different configurations.

4. A key comprising:

a key blank according to any of the preceding claims wherein said key combination surface has formed thereon key cuts which define a key combination.

5. A lock cylinder configured to be operated by a key according to claim 4, the lock comprising:

a housing;

a plug disposed in the housing, arranged for rotation

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relative thereto and defining a keyway;²⁴

a first plurality of chambers formed in the housing and a second plurality of chambers formed in the plug on one side of the keyway and being arranged such that each one of the first plurality of chambers extends coaxially with a corresponding one of the second plurality of chambers, when the plug is in a first rotational orientation relative to the housing;

first pin assemblies being disposed in the first plurality of chambers and second pin assemblies disposed in the second plurality of chambers;

a third pin assembly being disposed in the plug on a side of the keyway opposite to that of the second pin assemblies and being operative to urge said movable insert element outwardly into engagement with one of the second pin assemblies.

6. Apparatus according to any of the preceding claims and wherein said movable insert element is formed with a recess on its surface facing in the same direction as the key combination surface.

7. Apparatus according to any of the preceding claims and wherein the movable insert element is configurable to operate with telescopic plug pins.

8. A cylinder lock comprising:
a housing having a bore formed therein;
a plug arranged for rotation within the bore, the plug having a plurality of annular grooves formed on an outer surface thereof, the plug being formed with a keyway communicating with

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the outer surface; and

a key,



the bore including at least one curved protrusion which is arranged in juxtaposition with at least one of the plurality of annular grooves and the key being formed with at least one groove at an edge surface corresponding to the at least one protrusion and pin positioning recesses on one of the exterior surfaces lying perpendicular to the edge surface thereof.

9. A cylinder lock according to claim 8 and wherein the key is formed with different groove patterns at different edge surfaces thereof, thereby to fit different cylinder locks depending on the position of the key in the keyway.

10. A key for use with a cylinder lock according to either of the preceding claims 8 and 9 and comprising:

a generally elongate shaft portion defining a pair of planar surfaces, at least one of which defining a key combination surface adapted to have formed thereon key cuts which define a key combination and a pair of elongate edge surfaces, each of the pair of elongate edge surfaces being formed with a different groove pattern, thereby to fit different cylinder locks depending on the position of the key in the keyway.



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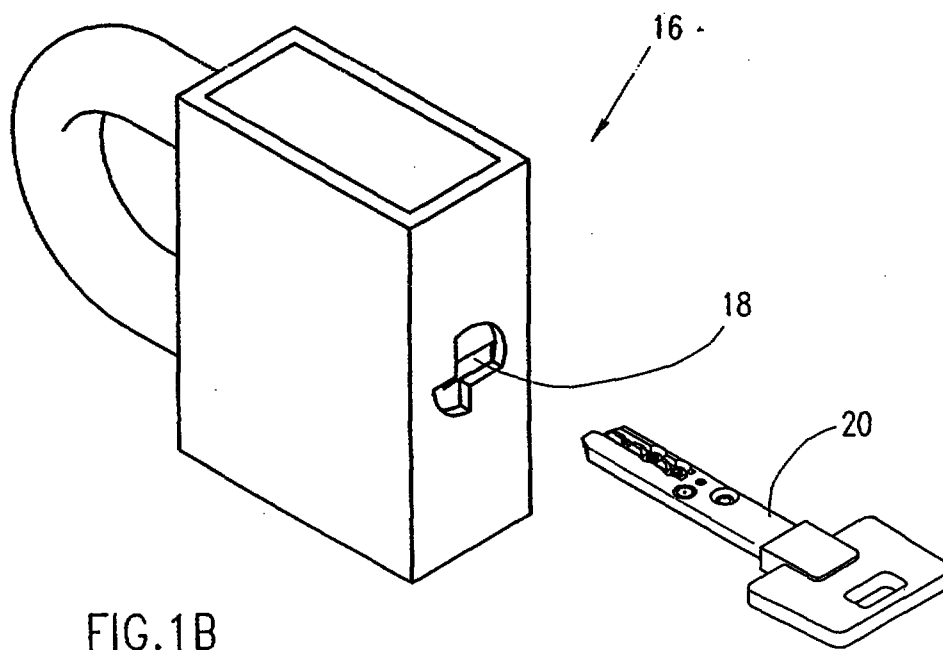
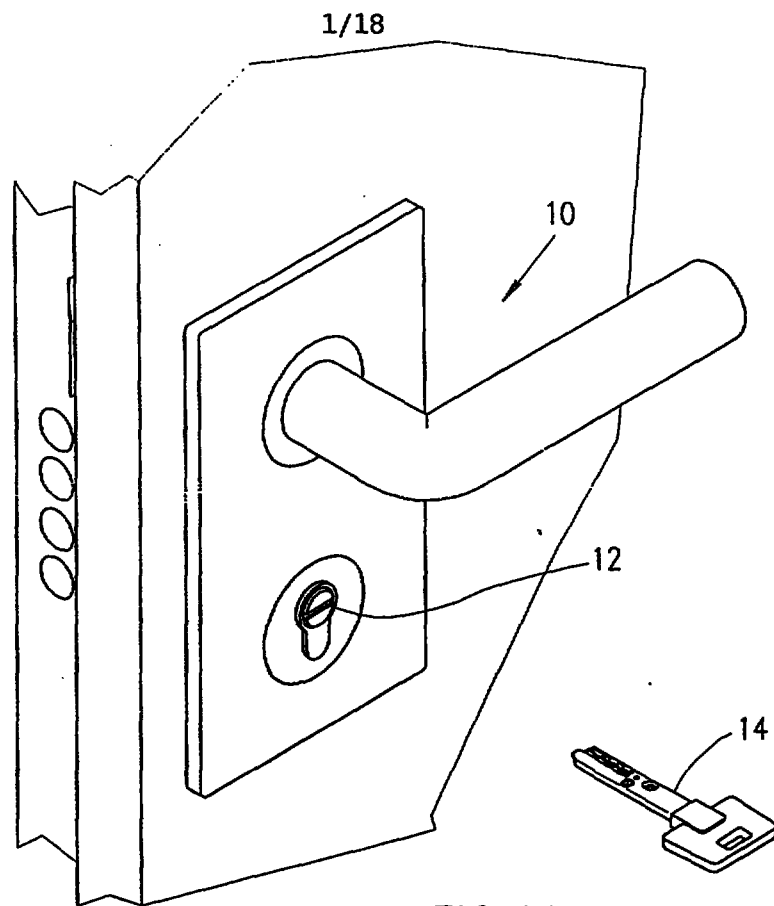
LOCKING APPARATUS

A key blank including a generally elongate shaft portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination, at least one movable insert element retained within the elongate shaft portion, the movable insert element being displaceable in a single direction, outwardly from the key combination surface.

Figure 1

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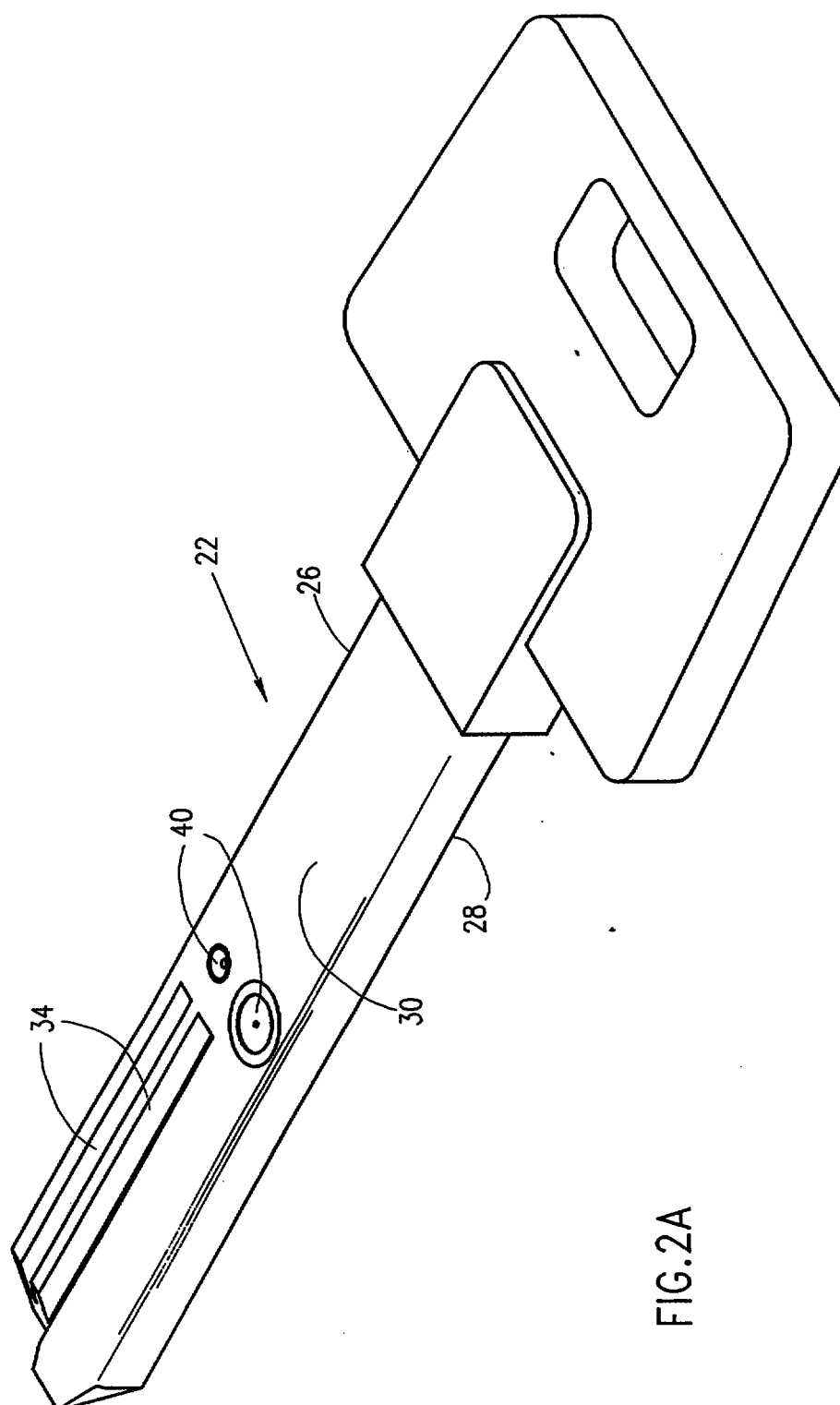
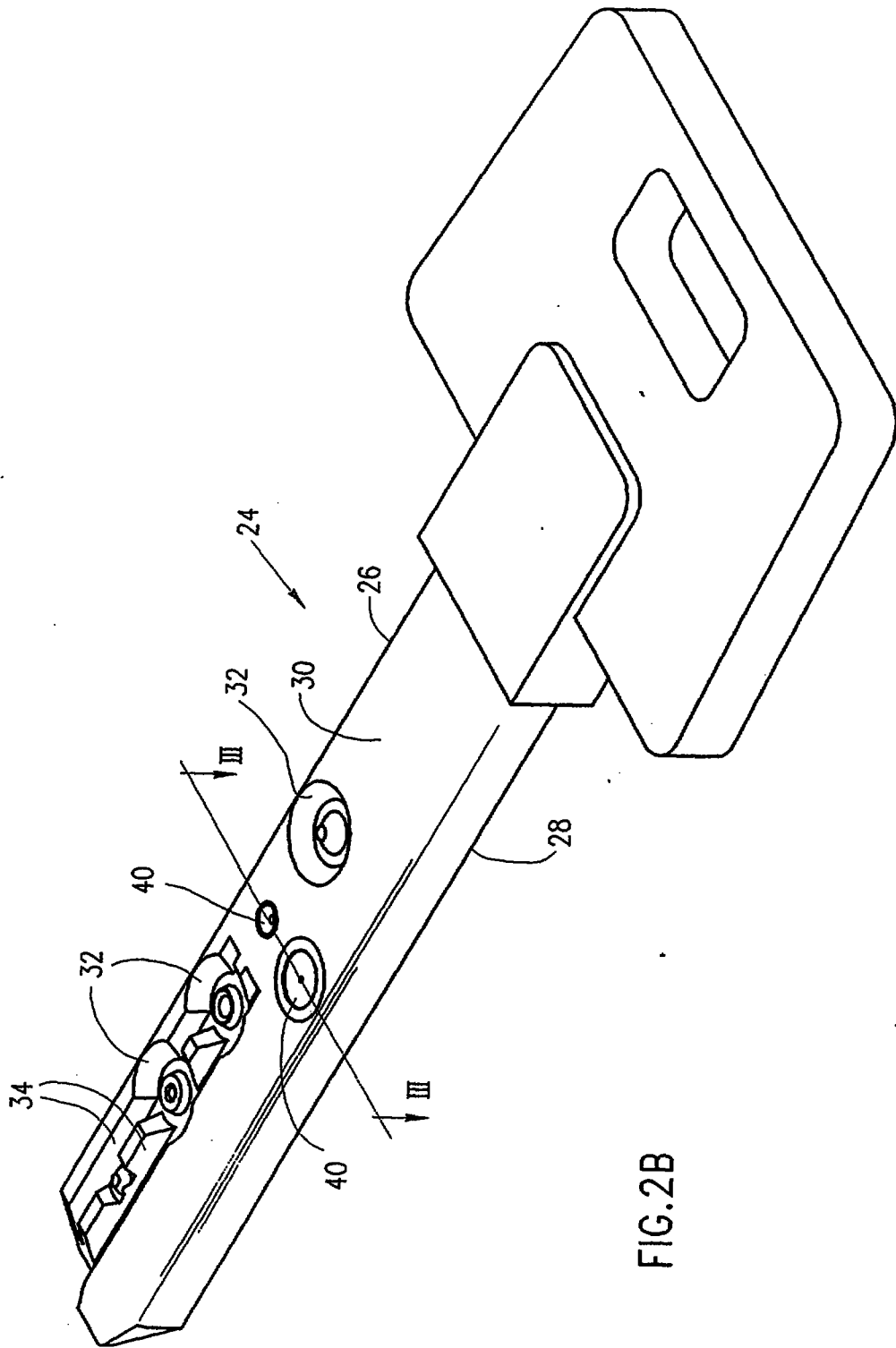


FIG. 2A



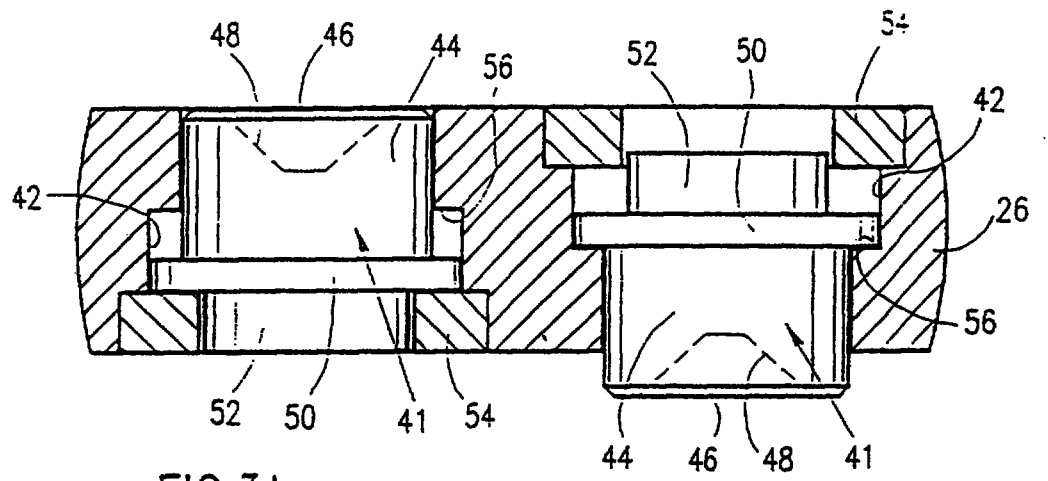


FIG. 3A

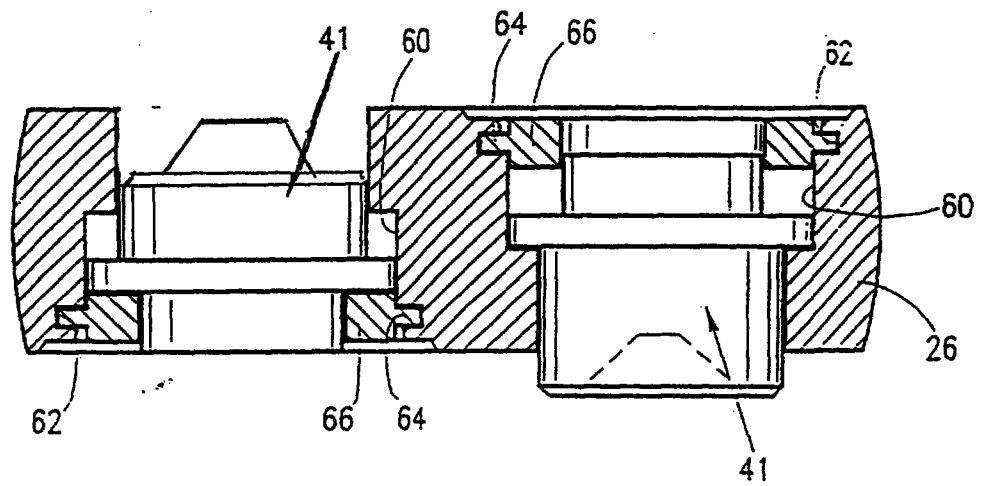


FIG. 3B

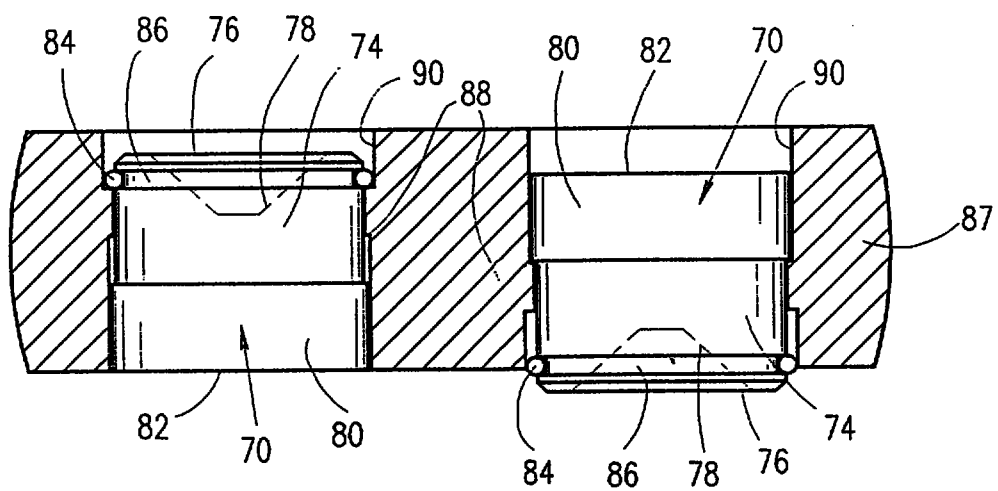


FIG. 3C

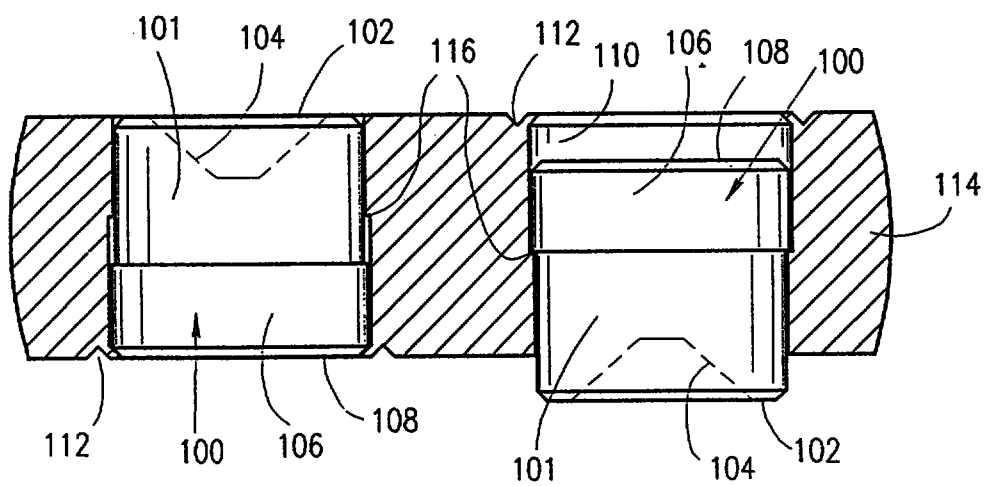


FIG. 3D

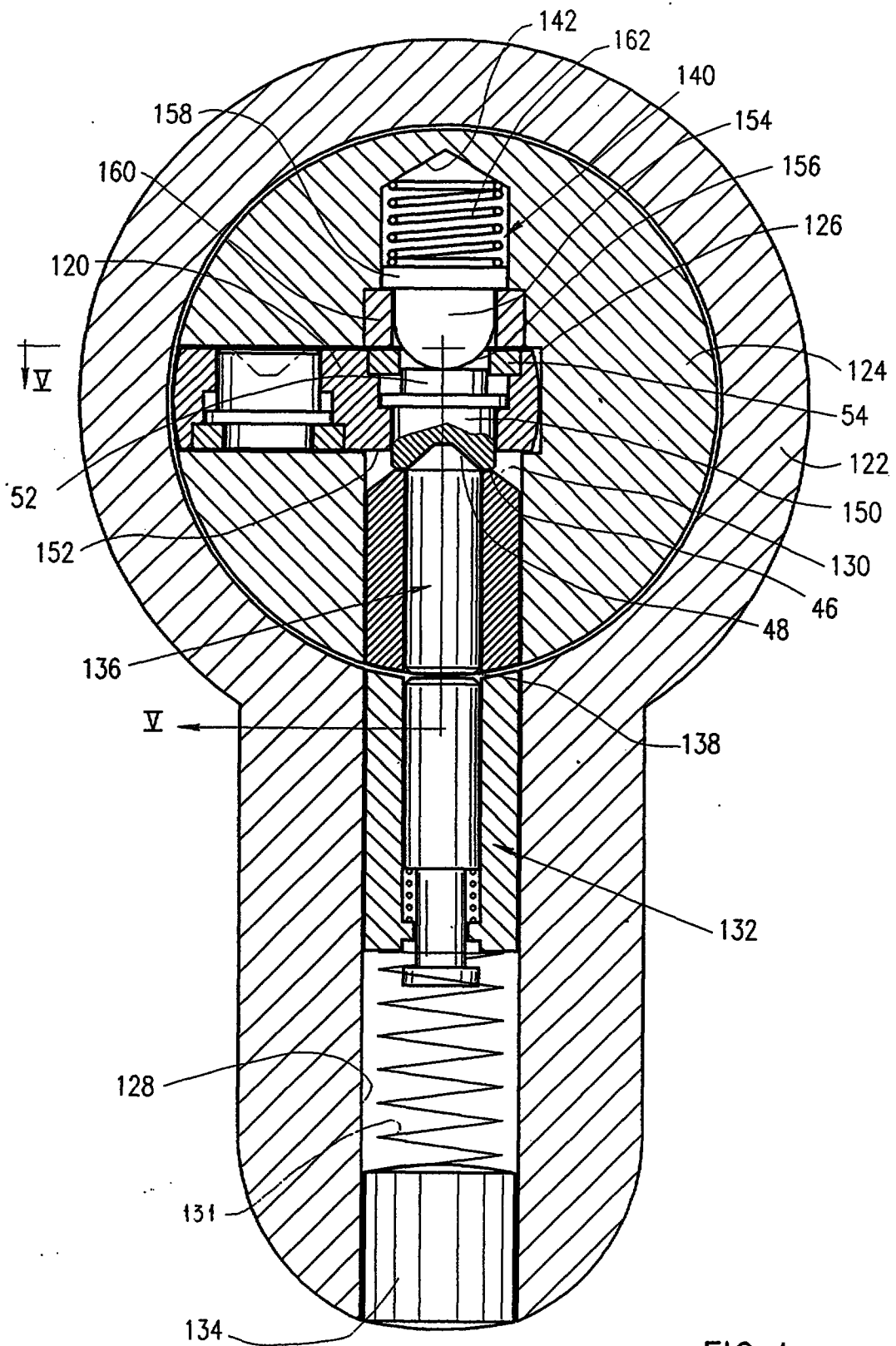


FIG. 4

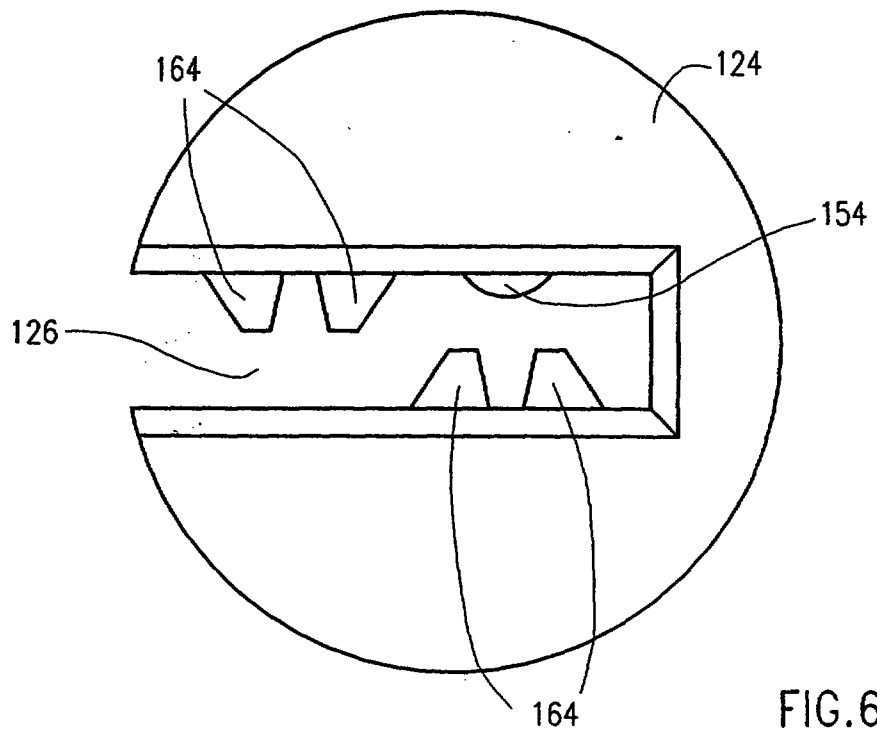
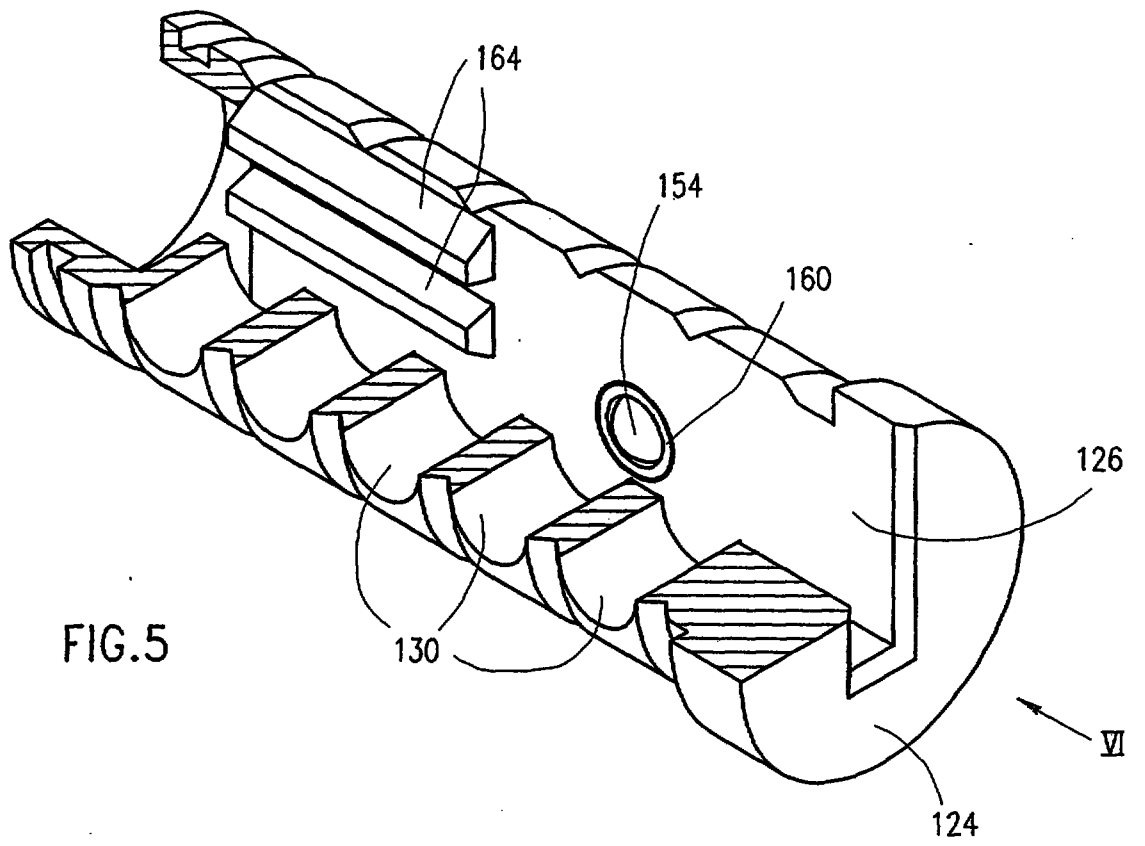


FIG.7A

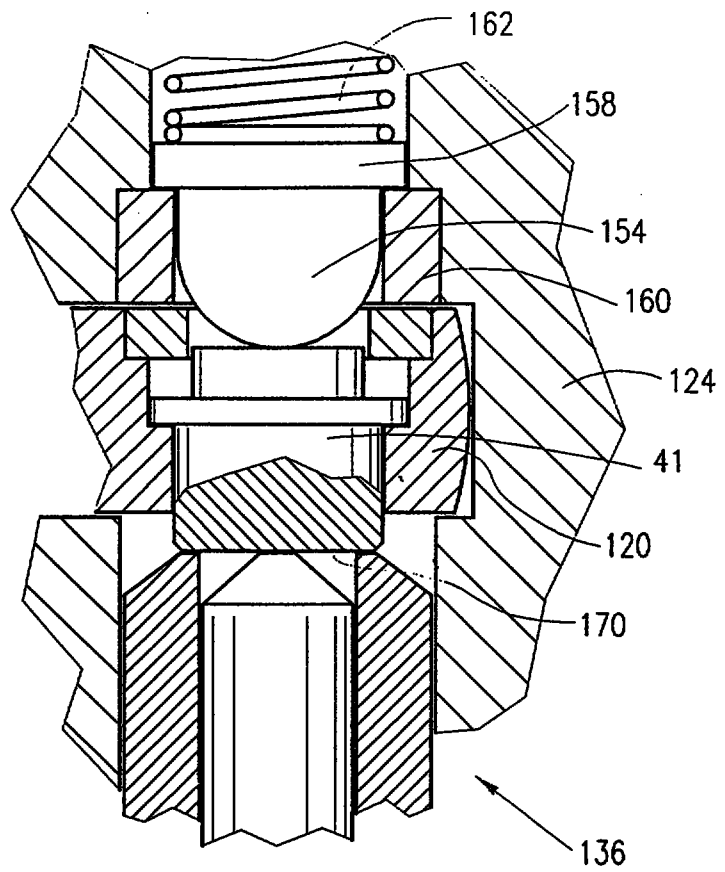
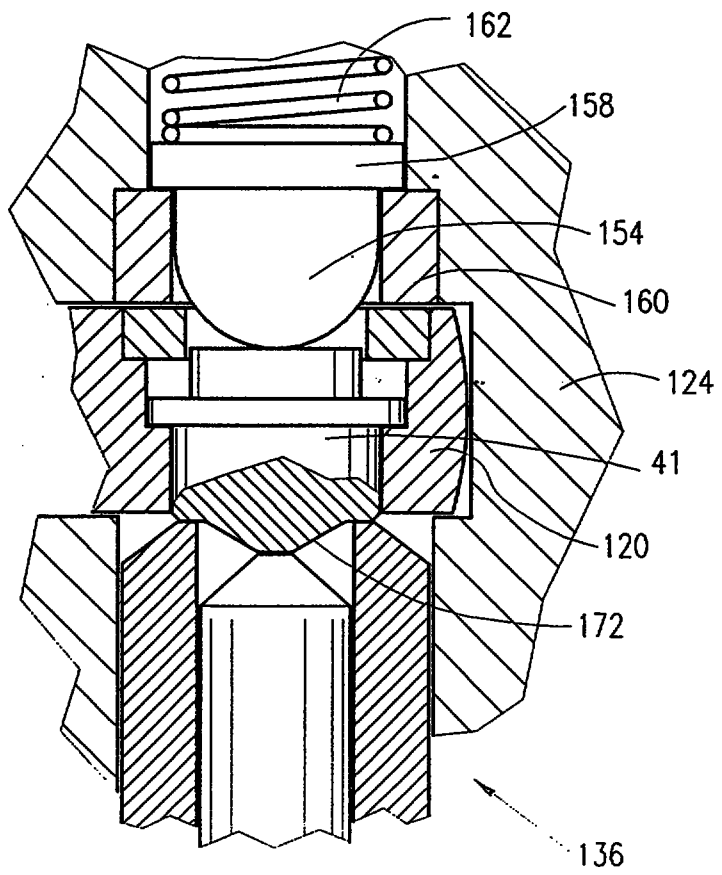
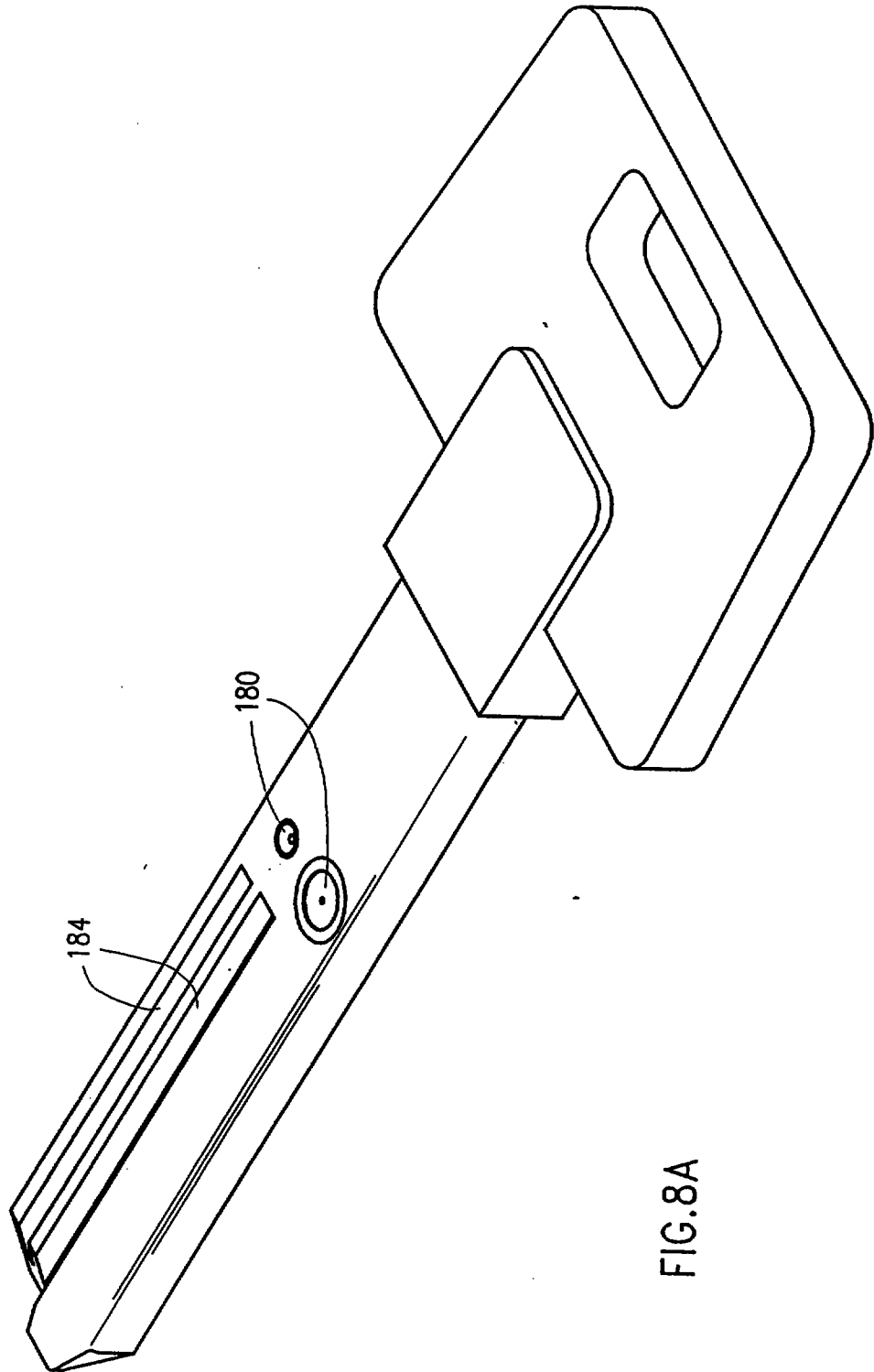


FIG.7B





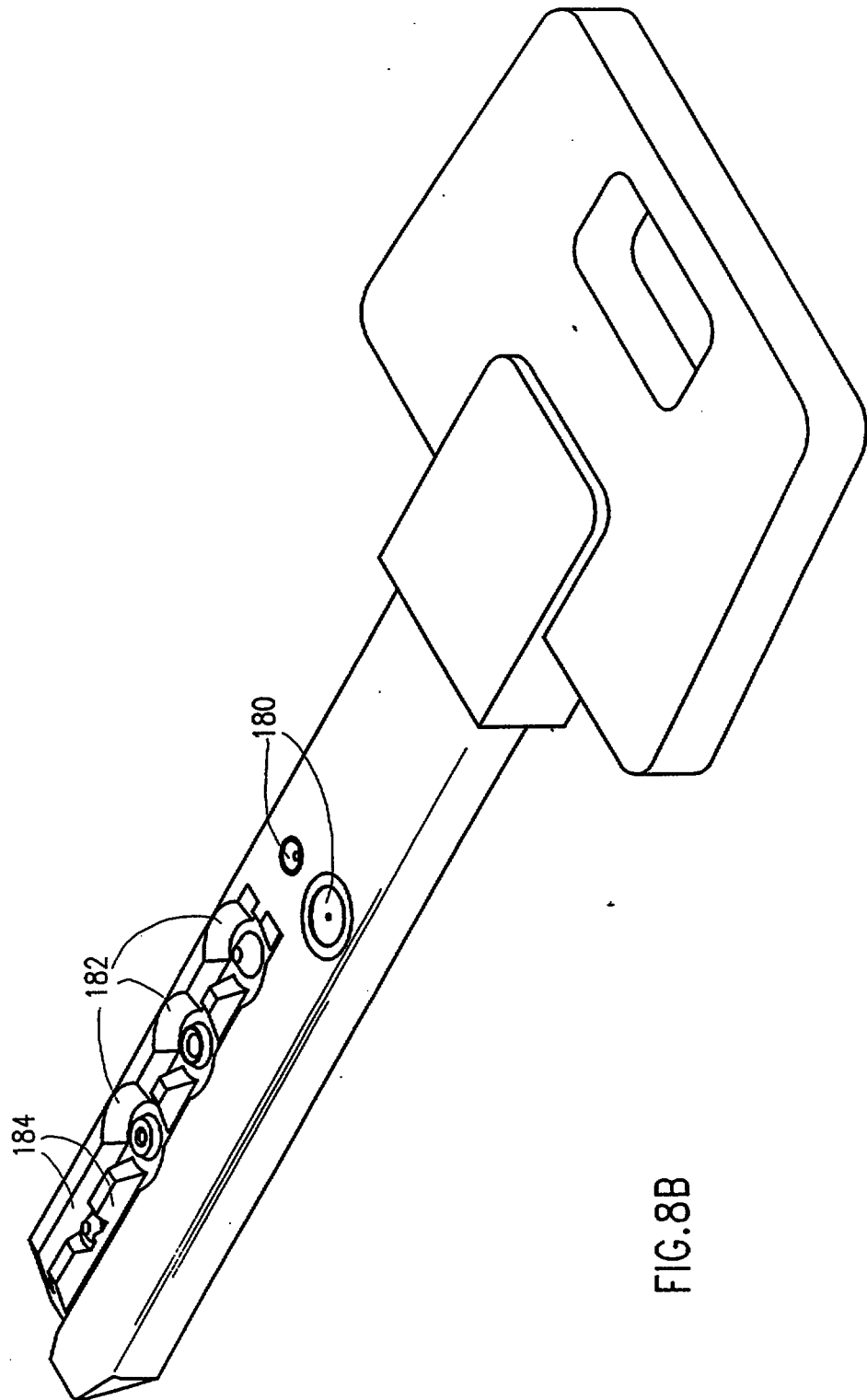
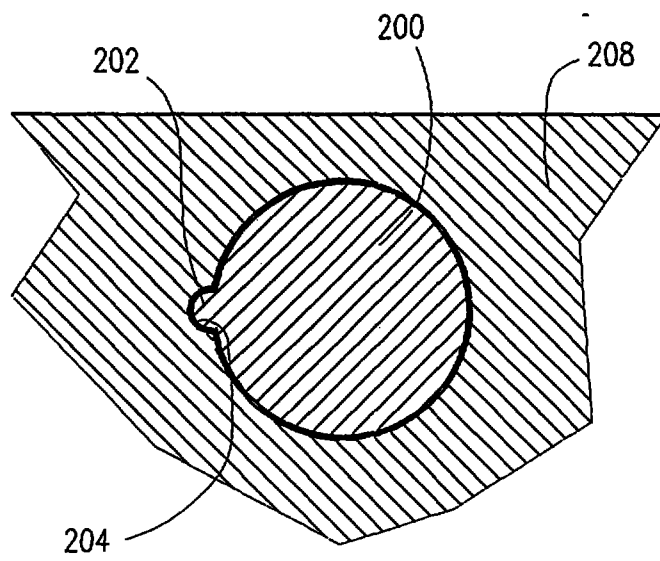
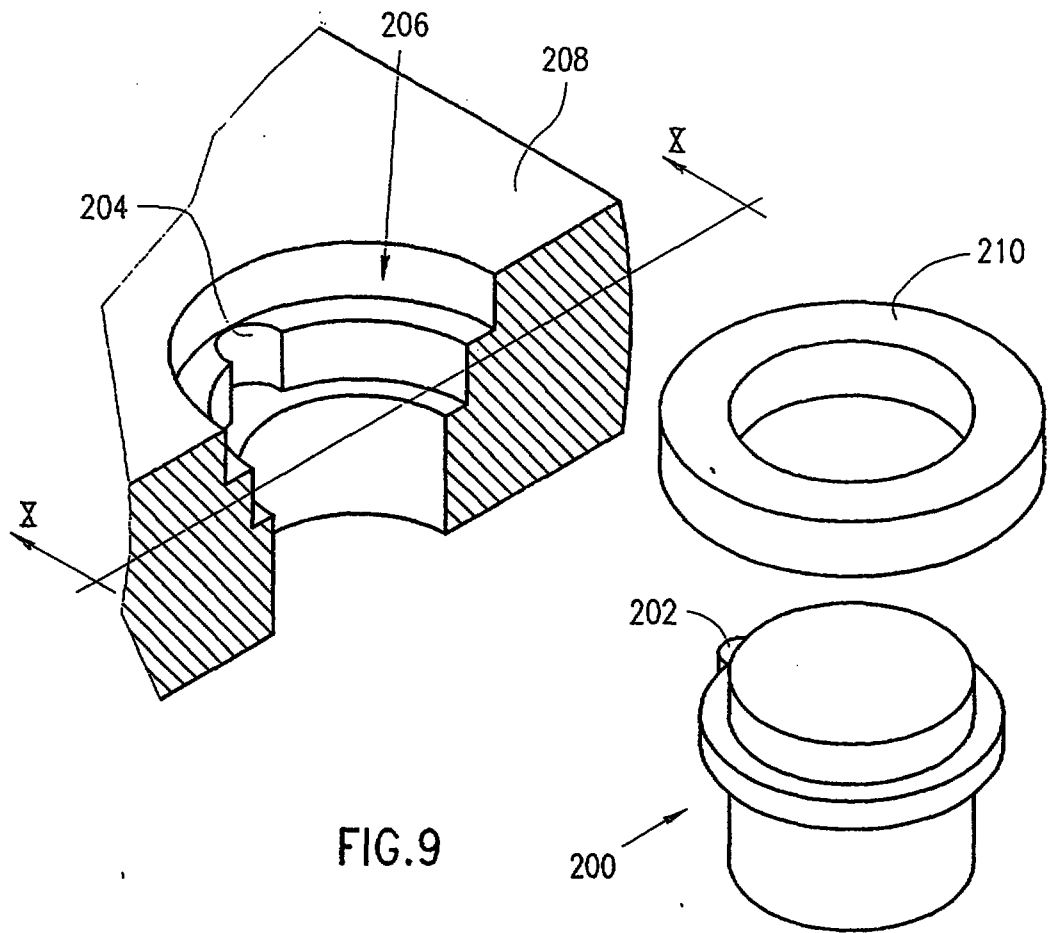


FIG. 8B



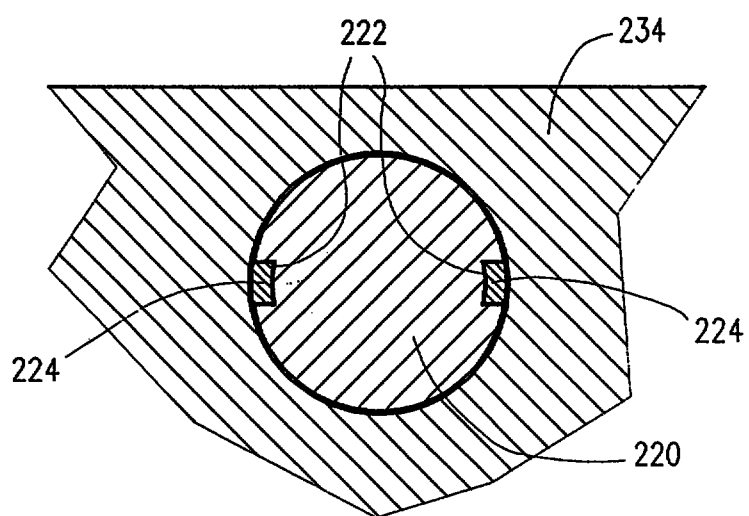
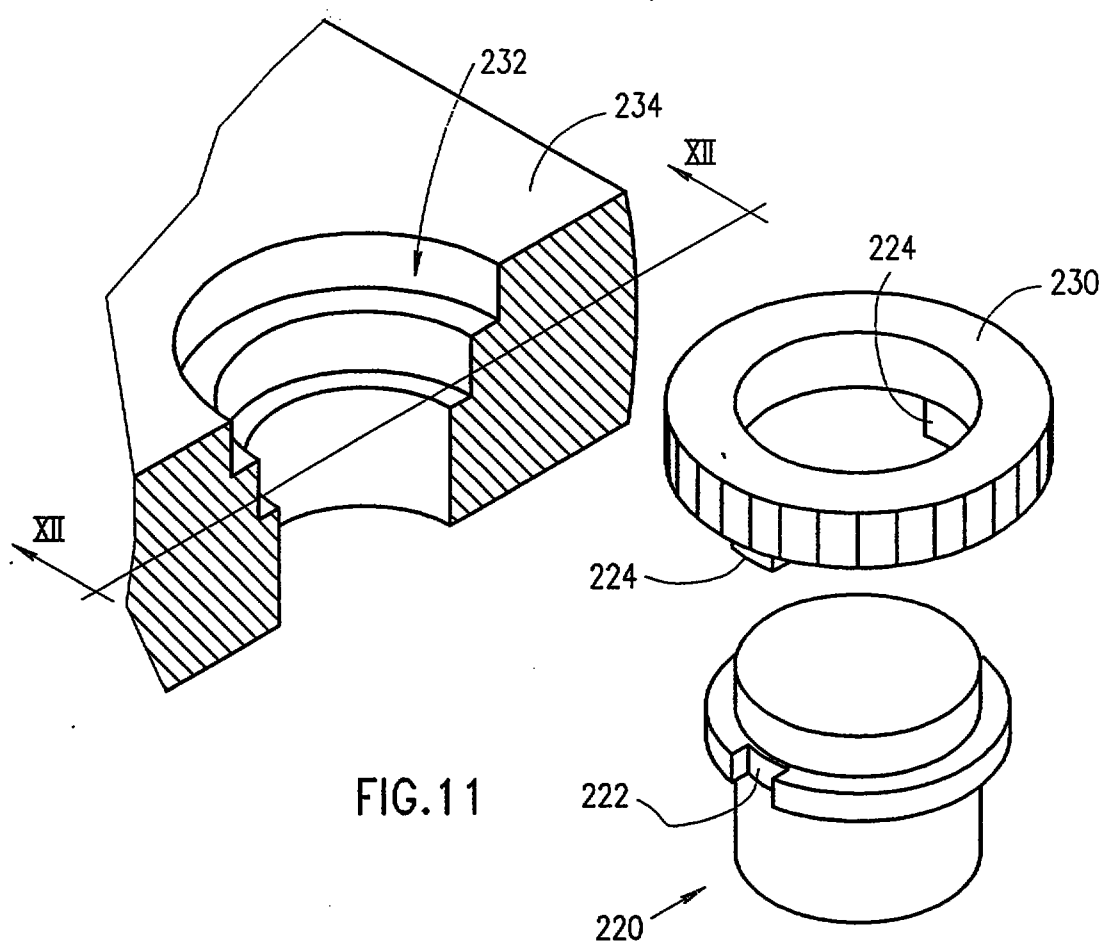
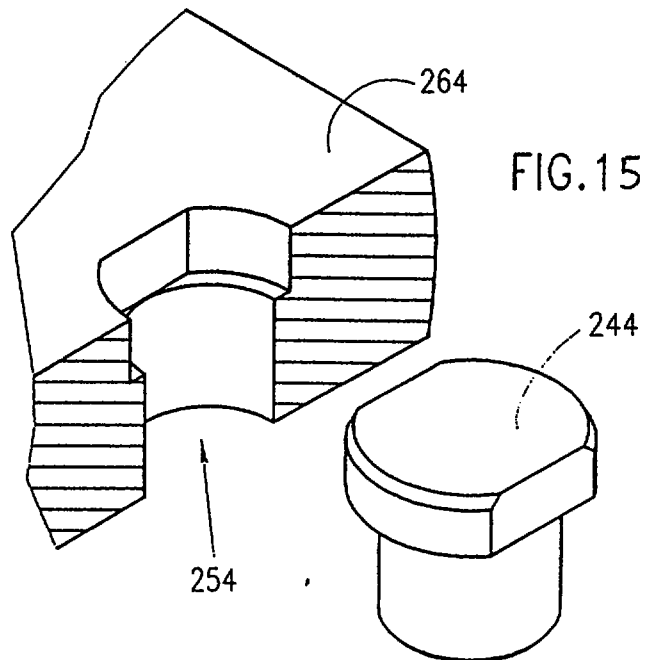
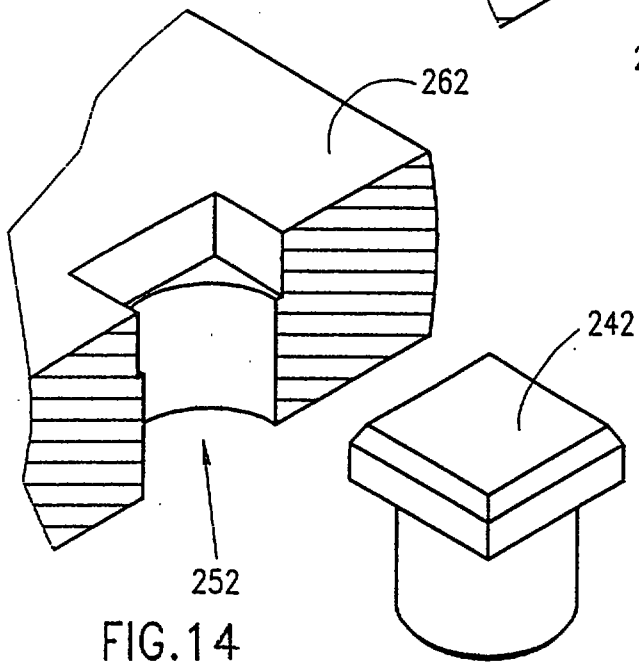
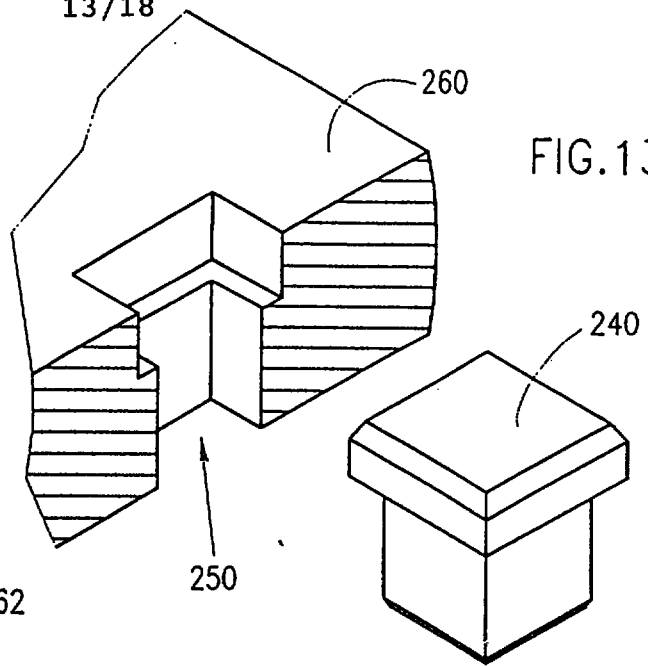


FIG.12

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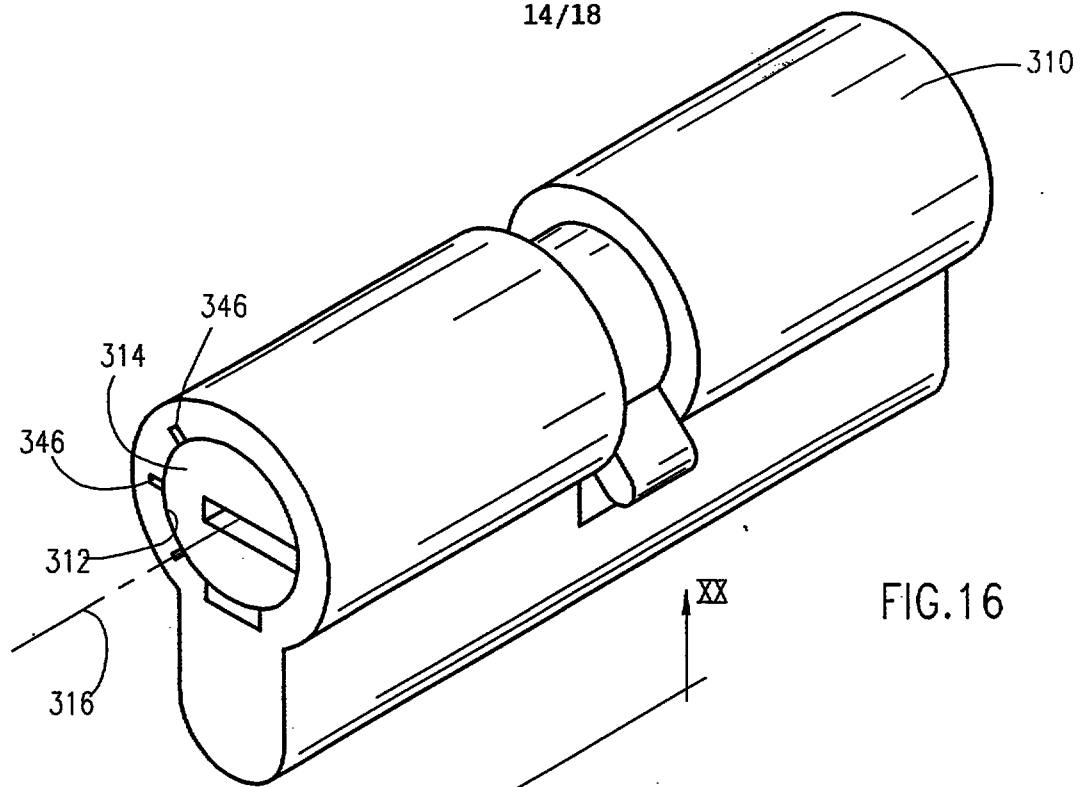


FIG. 16

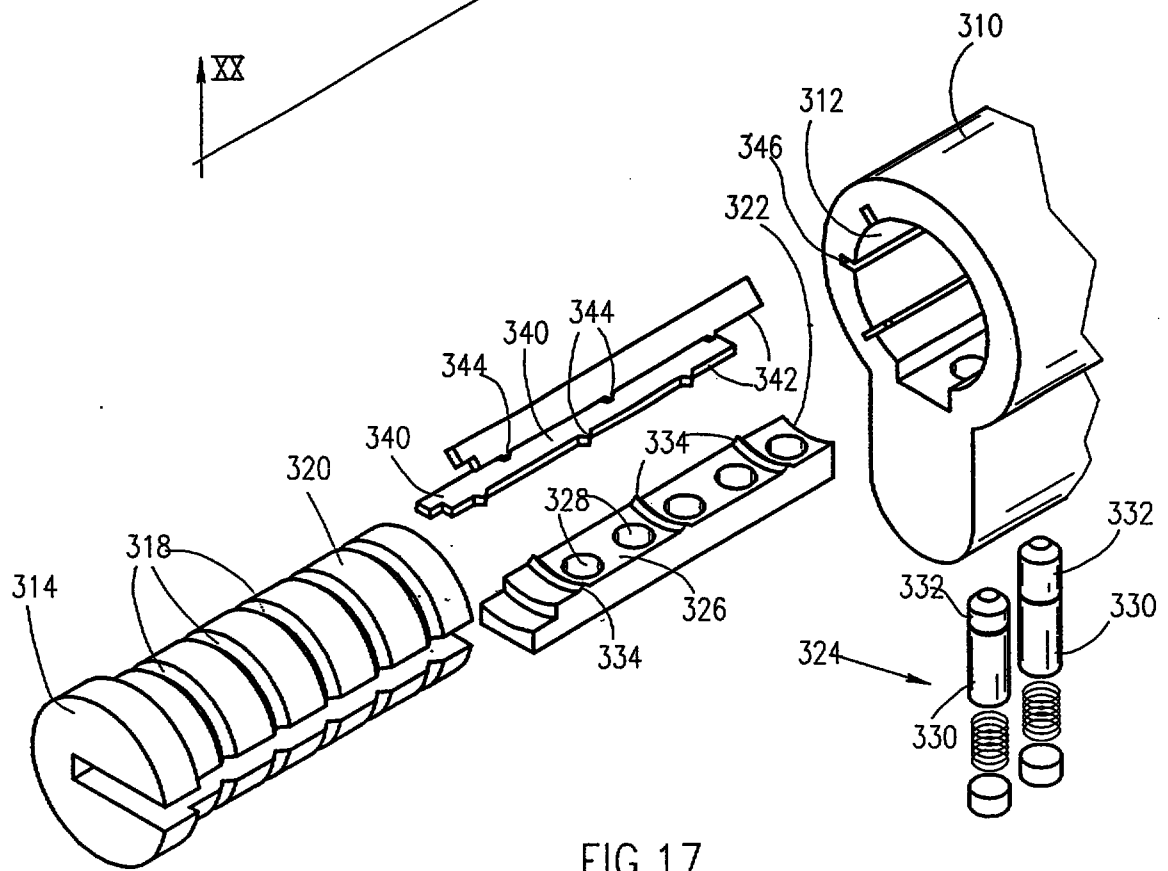
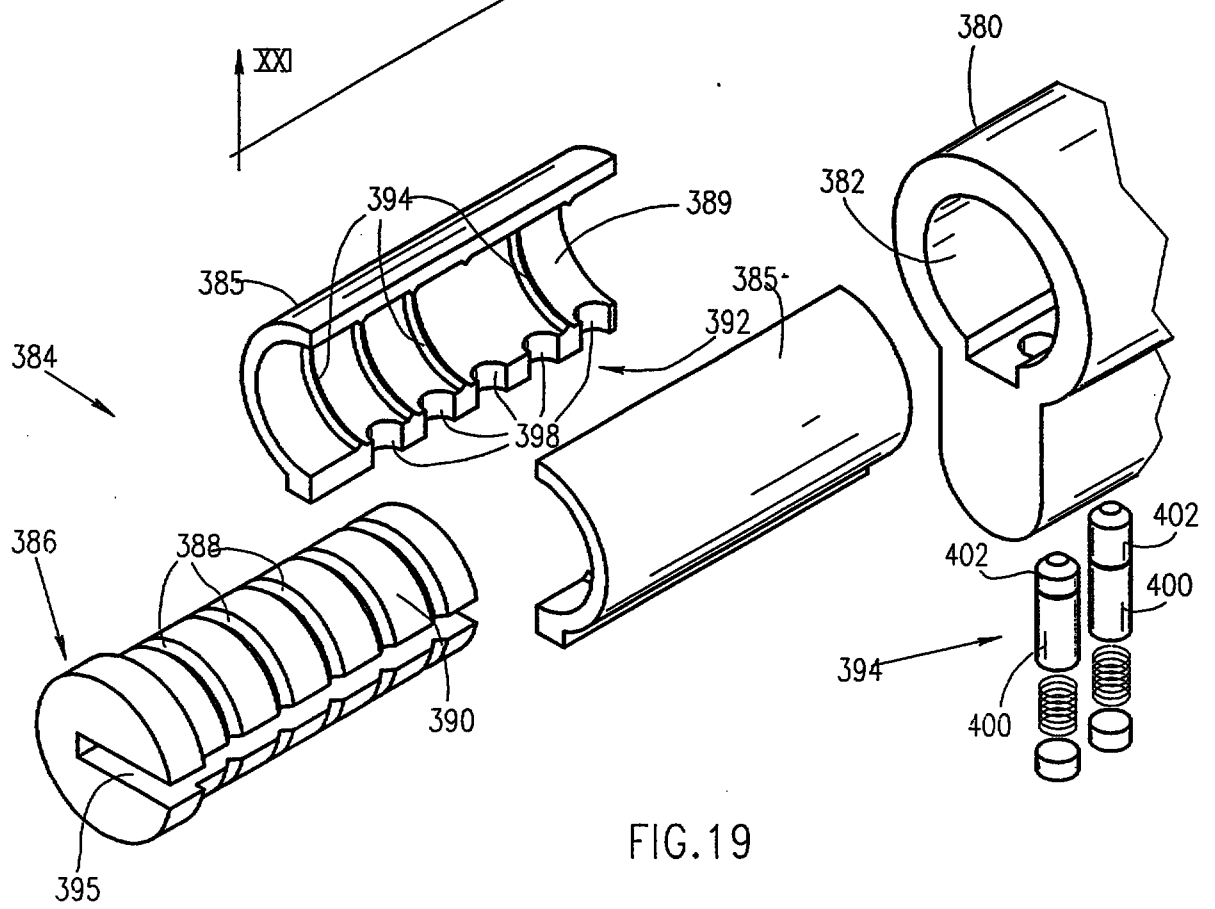
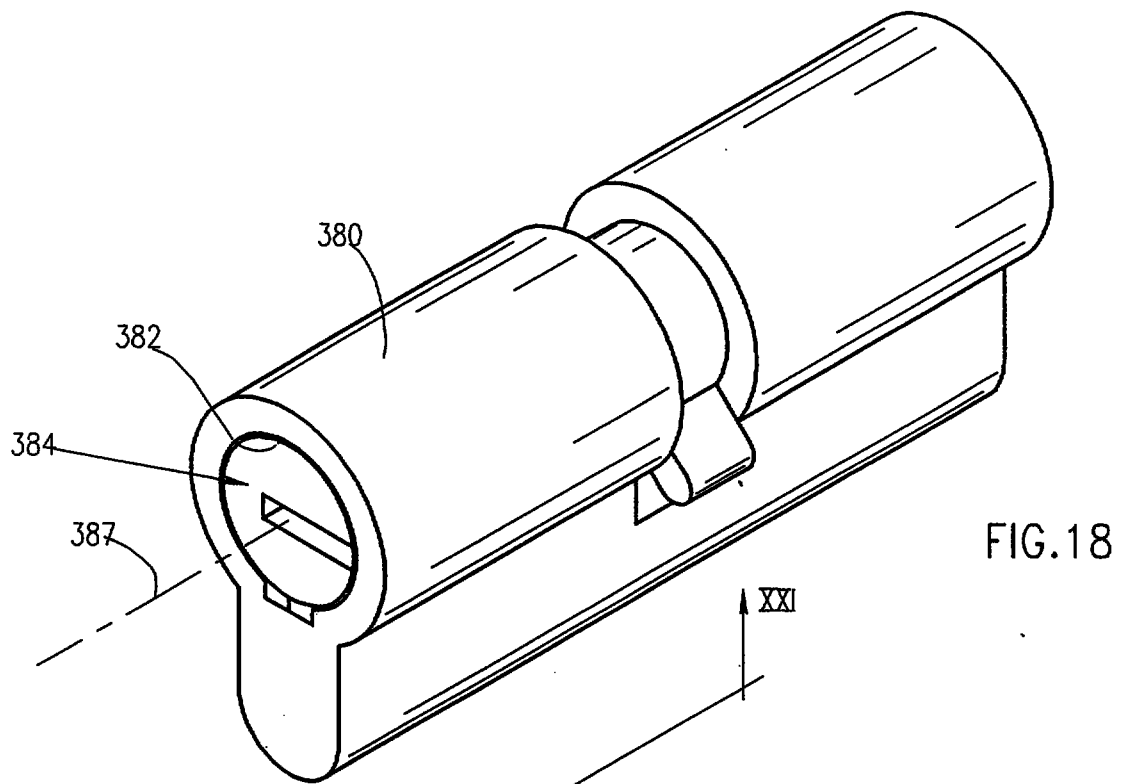


FIG. 17



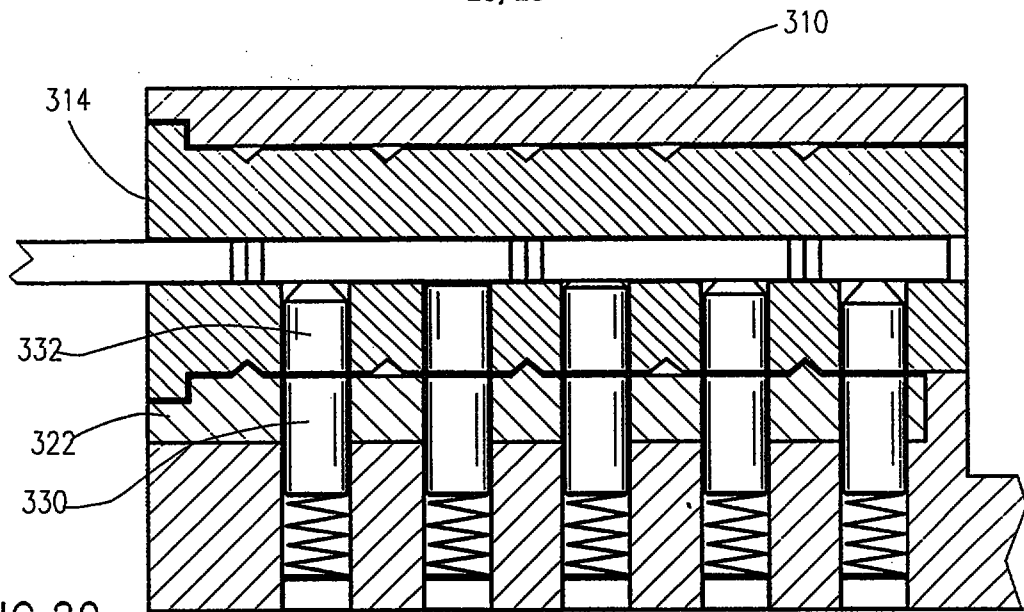


FIG. 20

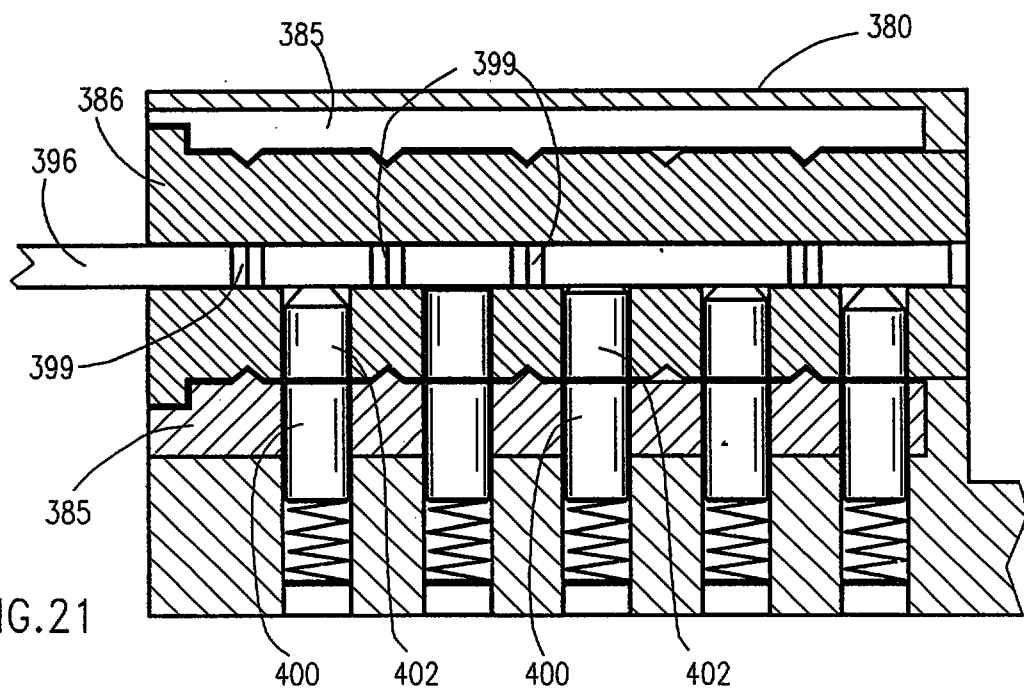


FIG. 21

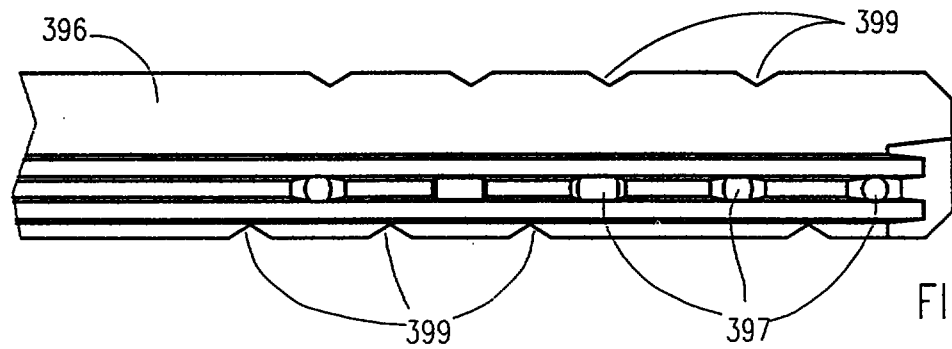


FIG. 22

FIG.23A

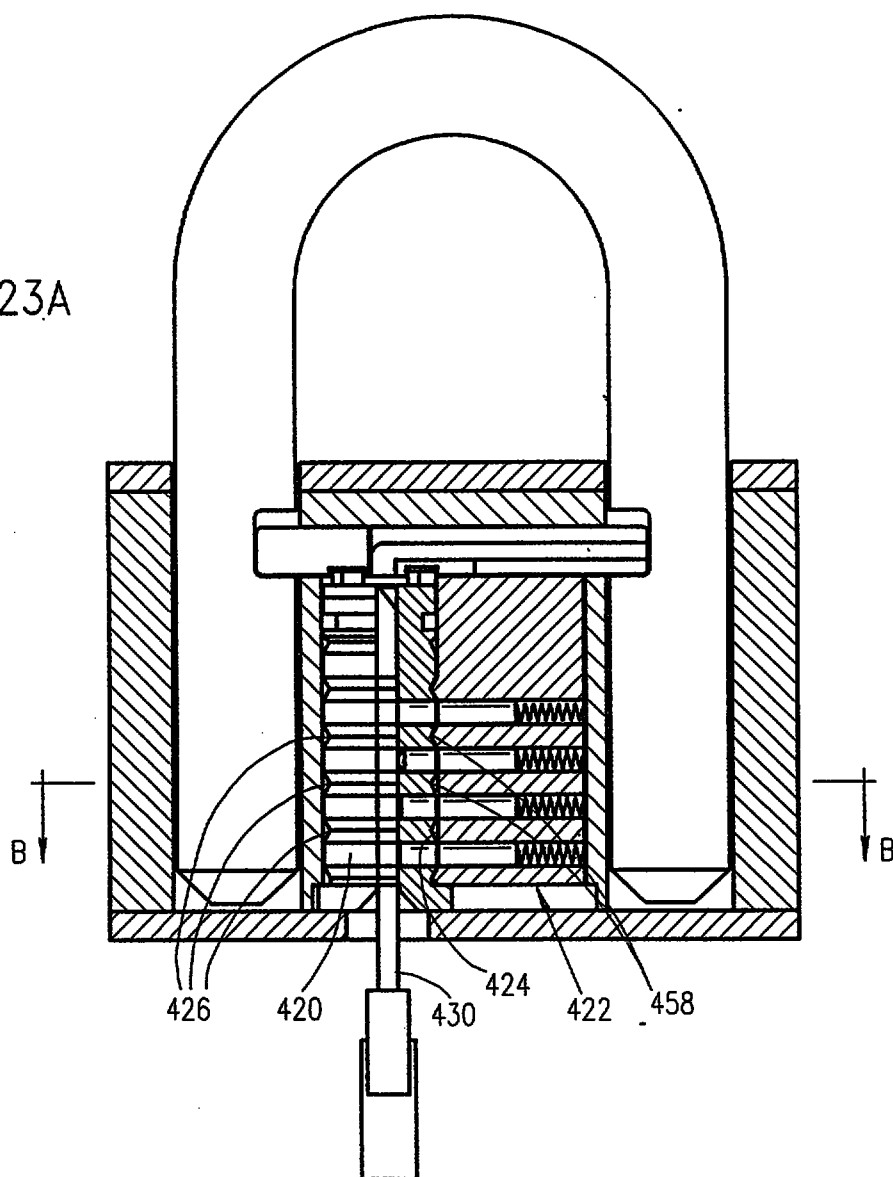


FIG.23B

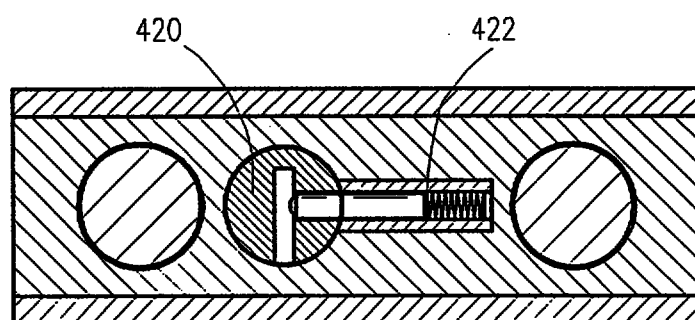


FIG. 26

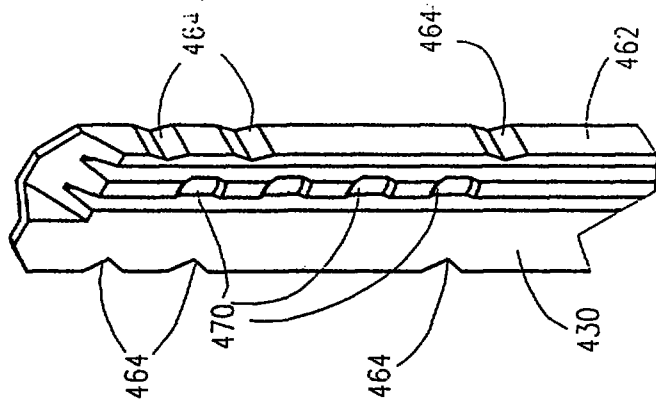


FIG. 25

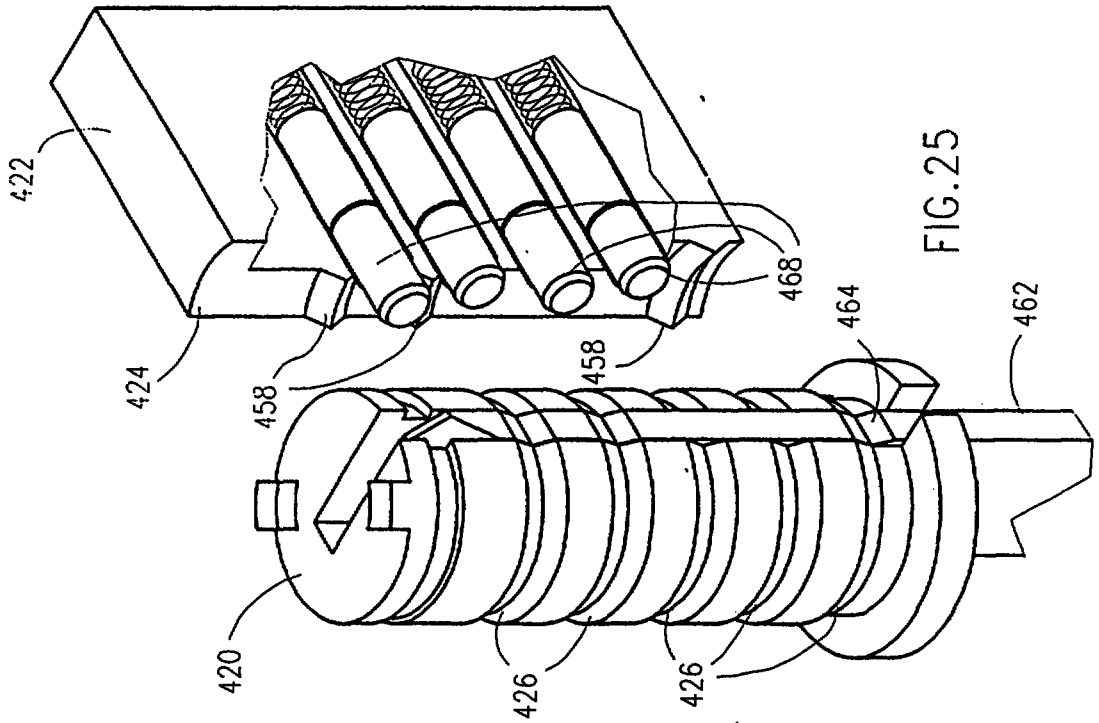
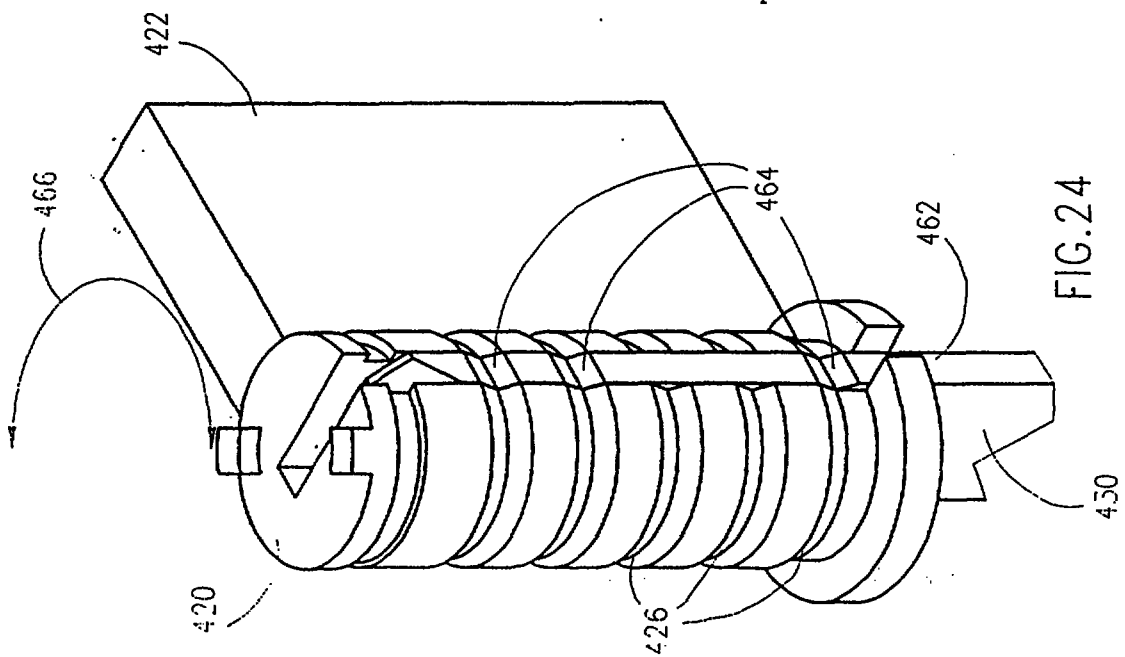
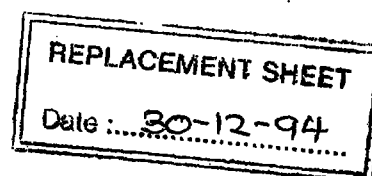


FIG. 24

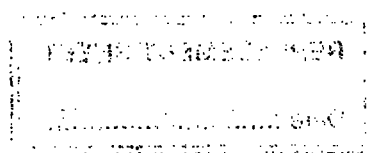




ABSTRACT / ZUSAMMENFASSUNG / ABREGE

93203734.4

A key blank (22) including a generally elongate shaft portion (26) defining a key combination surface (30) adapted to have formed thereon key cuts (32) which define a key combination, at least one movable insert element (40) retained within the elongate shaft portion (26), the movable insert element (40) being displaceable in a single direction, outwardly from the key combination surface (30).



LOCKING APPARATUS

The present invention relates to locking apparatus generally and more particularly to key blanks, keys and lock and key combinations.

A great variety of key blanks and associated locks are known. In the prior art, key blanks include a generally elongate unitary key cut-bearing portion with which is associated a key head. Various types of cylinder locks are also known.

Relevant patents include U.S. Patent 4,377,082; 5,123,268; 3,287,945; French Patents 82.01.905 and 84.03.944 and PCT published application 84.400.694.0.

US-A-4377082 discloses a cylinder-lock having a flat key comprising a shank having at least one profile longitudinal groove extending from the end thereof to accommodate a rib in the key-channel of the cylinder lock. The shank includes fixed key bits adapted to index pin-tumblers in the cylinder-lock. The key includes, in the area of the wide side of the shank, an additional movable key bit, said movable key bit being adapted to be controlled by a shoulder in the key-channel such that when the key is inserted, it induces an auxiliary tumbler into a position which allows the cylinder core of the lock to be rotated.

DE-A-34 24 307 discloses a lock and key combination based on a cylinder lock, including a rotatable core with a key channel. A key can be inserted into the key channel to push or turn blocking elements, in order to switch the lock from a locked to an unlocked mode, such that the core can be turned. The key has a flat shaft and includes a code element which can be pushed, turned or biased outwards from one of the flat sides of the shaft. In the key channel, the code element is forced into a widening or niche by means of spring forces, by the shape of the key channel or by magnetic forces. A displaceable mechanic or magnetic blocking element is situated in said widening or niche. The code element is positioned on the key in perpendicular orientation relative to the key bits, and therefore an auxiliary tumbler perpendicular to the other tumblers is required in the cylinder.

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EP-A-O 431 550 discloses a key for use with a locking device. The key comprises a profiled blade provided with a row of v-cuts on one narrow edge and a control element in the form of a pin accommodated for transverse movement in a bore extending through the key blade. EP-A-O 431 550 discloses the technical features defined in the preambles of claims 1, 6 and 13 of the present application.

The problem in the prior art devices to be solved by the present invention lies in that the movable pin elements of prior art devices, as in EP-A-O 431 550, require a special and non-standard type of cylinder body. This problem is overcome by the present invention as claimed.

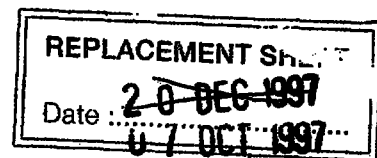
Hereinbelow some features of different embodiments of the claimed invention are set forth.

There is thus provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element being displaceable in a single direction, outwardly from the key combination surface.

There is also provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft portion defining a key combination surface adapted to have formed thereon at a subsequent time, a plurality of key cuts arranged in a row, which key cuts define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element arranged to lie along each row of key cuts.

There is additionally provided in accordance with a preferred embodiment of the present invention a key or key blank including a generally elongate shaft

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portion defining a key combination surface adapted to have formed thereon key cuts which define a key combination, the key blank including a movable insert element retained within the elongate shaft portion, the movable insert element being selectably configurable to provide multiple combinations.

In accordance with one embodiment of the present invention, the movable insert element is configurable prior to its insertion in the key blank.

In accordance with another preferred embodiment of the present invention, the movable insert element may be configurable following its insertion in the key blank. Preferably the configuration of the movable insert element can be carried out using the same key cutting apparatus used for cutting the remaining key cuts on the key blank.

The key blank may also comprise a retractable cover member for covering part of the shaft including the movable insert element, when it is not inserted in a lock keyway.

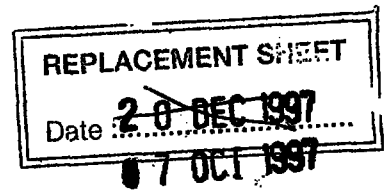
Preferably, the key blank is a reversible key blank arranged to have formed thereon a pair of opposite key combination surfaces and includes a pair of movable insert elements, each associated with one of the key combination surfaces.

In accordance with a preferred embodiment of the invention one or more movable insert elements may be provided having the same or different configurations. In such a case, depending on the orientation of the key it is operative to operate two different and mutually exclusive master key systems.

Additionally in accordance with a preferred embodiment of the present invention there is provided a lock and key combination wherein the lock comprises a lock cylinder configured to be operated by a key of any of the types described hereinabove, the lock comprising:

a housing;

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a plug disposed in the housing, arranged for rotation relative thereto and defining a keyway;

a first plurality of chambers formed in the housing and a second plurality of chambers formed in the plug on one side of the keyway and being arranged such that each one of the first plurality of chambers extends coaxially with a corresponding one of the second plurality of chambers, when the plug is in a first rotational orientation relative to the housing;

first pin assemblies being disposed in the first plurality of chambers and second pin assemblies being disposed in the second plurality of chambers;

a third pin assembly being disposed in the plug on a side of the keyway opposite to that of the second pin assemblies and being operative to urge said movable insert element outwardly into engagement with one of the second pin assemblies.

The lock cylinder may be employed in any suitable kind of lock, such as a door lock, a padlock or a gear-shift lock.

In accordance with a preferred embodiment of the present invention, the movable insert element is formed with a recess on its surface facing in the same direction as the key combination surface.

Additionally in accordance with a preferred embodiment of the present invention, the movable insert element may operate with telescopic plug pins.

There is further provided in accordance with a preferred embodiment of the present invention lock and key combination wherein the lock is a cylinder lock including a lock shell having a cylindrical bore formed therein, a plug arranged for rotation within the cylindrical bore, the plug having a plurality of annular grooves formed on an outer surface thereof, the plug being formed with a keyway communicating with the outer surface; a hive, including a plurality of pin assemblies therein and being arranged for operative engagement with a corresponding plurality of plug pin assemblies located within the plug and a key having a plurality of exterior surfaces, one of which being an edge surface which communicates with the outer surface of the plug, the cylinder lock being

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characterized in that the hive includes at least one protrusion which is arranged in juxtaposition with at least one of the plurality of annular grooves and the key is formed with at least one groove at its edge surface corresponding to the at least one protrusion.

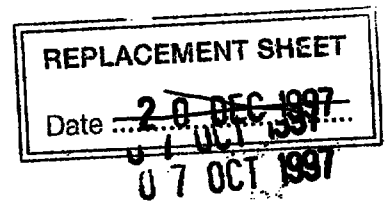
In accordance with a preferred embodiment of the present invention, the key is formed with pin positioning recesses on one of the exterior surfaces lying perpendicular to the edge surface thereof.

Further in accordance with a preferred embodiment of the present invention, there is provided a key blank having an elongate shaft portion including a pair of side surfaces arranged to receive pin positioning recesses and a pair of edge surfaces, at least one of which is formed with at least one groove extending thereacross in a direction perpendicular to the longitudinal axis of the elongate shaft portion.

Additionally, in accordance with a preferred embodiment of the present invention, there may be provided additional protrusion bearing members associated with the lock shell and having protrusions extending into one or more of the annular grooves on the plug.

In accordance with a further embodiment of the invention, there is provided a lock and key combination wherein the lock is a cylinder lock including a lock shell having a bore formed therein, a bore lining element disposed in the bore and defining an inner bore having at least one annular protrusion therein, a plug arranged for rotation within the inner bore, the plug having at least one annular groove formed on an outer surface thereof, the plug being formed with a keyway communicating with the outer surface; a hive, including a plurality of pin assemblies therein and being arranged for operative engagement with a corresponding plurality of plug pin assemblies located within the plug and a key having a plurality of exterior surfaces, one of which being an edge surface which communicates

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with the outer surface of the plug, the cylinder lock being characterized in that the key is formed with at least one groove at its edge surface corresponding to the at least one protrusion.

It is appreciated that the cylinder lock ~~of the present invention~~ may be employed in any suitable application, such as door locks, padlocks and the like and may appear in any suitable configuration.

It is a particular feature of the present invention that the ward is retained in place by the body pins which prevent removal of the ward even when a correct key is inserted into the keyway. The only practical way to remove the ward is by removing the pin and spring assemblies.

The structure of the present invention enables the ward, which may be made of hardened metal, to provide additional protection to the body pins and to the shear line defined between the plug and the ward.

Additionally in accordance with a preferred embodiment of the present invention, the protrusions formed on the ward act to prevent the operation of the well-known technique of inserting shims between the plug and the lock shell.

~~BRIEF DESCRIPTION OF THE DRAWINGS~~

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Figs. 1A and 1B are pictorial illustrations showing two types of locks and keys;

Figs. 2A and 2B are pictorial illustrations of a key blank and a key, respectively;



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~~DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT~~

Reference is now made to Figs. 1A and 1B which illustrate a key and cylinder lock constructed and operative in accordance with a preferred embodiment of the present invention. Fig. 1A illustrates a door lock 10 employing a cylinder 12 and key 14 according to the present invention, and Fig. 1B illustrates a padlock 16 employing a cylinder 18 and key 20 according to the present invention.

Broadly speaking, the key and the key blank used to produce the key are characterized in that they include at least one and preferably two movable insert elements having at least one of the following characteristics:

The insert element is arranged for movement in a single direction perpendicular to the plane of the key and the lock keyway.

The insert element is non-rotatable with respect to the remainder of the key.

The insert element is selectably configurable so as to define a plurality of different permutations.

The insert element includes a recess.

The insert element is arranged to lie along a row of key cuts conventionally formed in the key and thus operates a conventional plug pin of the lock.

A pair of insert elements having different configurations are associated with opposite key combination surfaces, thus providing a double function key and key blank.

These and other features of the key blank, key and lock of the present invention will be described hereinbelow with



CLAIMS

1.- A key blank (22) comprising:

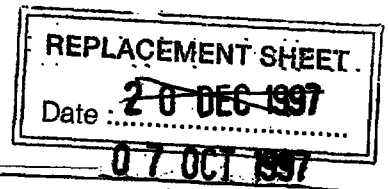
5 a generally elongate shaft portion (26)
extending along a shaft axis and defining first and second
generally flat oppositely directed side surfaces (28, 30),
joined by edge surfaces narrower than said side surfaces,
said first side surface (28) defining a first key combina-
tion surface and having formed thereon elongate keyway
10 guides (34, 184) extending at least partly along a first
keyway guide axis, parallel to said shaft axis; and at
least one first movable pin element (40, 180) retained
within the elongate shaft portion (26),

characterized in that

15 the at least one first movable pin element (40, 180)
extends along a first movable pin axis, located along said
first keyway guide axis, said movable pin axis being
perpendicular to said first keyway guide axis, wherein said
20 pin element (40, 180) extends from said first side surface
(28) to said second side surface (30) and is displaced
axially along said first movable pin axis from said second
side surface inwardly towards said first side surface (28),
such that when said at least one first movable pin element
25 (40, 180) is recessed with respect to said second side
surface (30) it protrudes outwardly from said first side
surface (28).

30 2.- A key blank according to claim 1 and further characte-
rized in that:

said second side surface (30) also defines a
second key combinaton surface and has formed thereon
elongate keyway guides (34, 184) extending at least partly
along a second keyway guide axis, parallel to said shaft
35 axis and to said first keyway guide axis; and



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at least one second movable pin element (40, 180) is retained within the elongate shaft portion (26) at a location along said second keyway guide axis, the at least one second movable pin element (40, 180) extending
5 along a second movable pin axis, perpendicular to said second keyway guide axis and parallel to said first movable pin axis, from said first side surface (28) to said second side surface (30) and being displaceable axially along said second movable pin axis from said first side surface (28)
10 inwardly towards said second side surface (30), such that when said at least one second movable pin element (40, 180) is recessed with respect to said first side surface (28) is protrudes outwardly from said second side surface (30).

15 3.- A key blank according to claim 2 and further characterized in that said at least first and second movable pin elements (40, 180) are laterally offset one from the other.

20 4.- A key blank according to claim 1 and further characterized in that at least one first movable pin element (40, 180) is retained within the elongate shaft portion (26) at a location along said first keyway guide axis so that it cannot protrude from said second side surface (30).

25 5.- A key blank according to claim 2 and further characterized in that at least one second movable pin element (40, 180) is retained within the elongate shaft portion (26) at a location along said second keyway guide axis so that it cannot protrude from said first side surface (28).

30

6.- A key (24) comprising:

a generally elongate shaft portion (26) extending along a shaft axis and defining first and second generally flat oppositely directed side surfaces (28, 30),
35 joined by edge surfaces narrower than said side surfaces,

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5 said first side surface (28) defining a first key combination surface and having formed thereon elongate keyway guides (34, 184) extending at least partly along a first keyway guide axis, parallel to said shaft axis and a row of key cuts (32, 182) which define a key combination, arranged along said first keyway guide axis; and at least one first movable pin element (40, 180) retained within the elongate shaft portion (26),

10 characterized in that

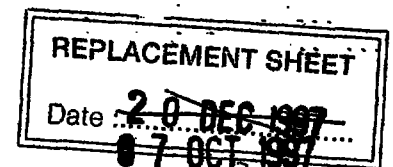
15 the at least one first movable pin element (40, 180) extends along a first movable pin axis, located along said first keyway guide axis, said movable pin axis being perpendicular to said keyway guide axis, wherein said pin element (40, 180) extends from said first side surface (28) to said second side surface (30) and is displaced axially along said first movable pin axis from said second side surface (30) inwardly towards said first side surface (28),
20 such that when said at least one first movable pin element (40, 180) is recessed with respect to said second side surface (30) it protrudes outwardly from said first side surface (28) along said row of key cuts (32, 182).

25 7.- A key according to claim 6 and further characterized in that:

30 said second side surface (30) also defines a second key combination surface having formed thereon elongate keyway guides (34, 184) extending at least partly along a second keyway guide axis, parallel to said shaft axis and to said first keyway guide axis and a row of key cuts (32, 182) which define a key combination, arranged along said second keyway guide axis; and

35 at least one second movable pin element (40, 180) is retained within the elongate shaft portion (26) at

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5 a location along said second keyway guide axis, the at
least one second movable pin element (40, 180) extending
along a second movable pin axis, perpendicular to said
second keyway guide axis and parallel to said first movable
pin axis, from said first side surface (28) to said second
side surface (30) and being displaceable axially along said
second movable pin axis from said first side surface (28)
inwardly towards said second side surface (30), such that
when said at least one second movable pin element is
10 recessed within respect to said first side surface (28) it
protrudes outwardly from said second side surface (30).

15 8.- A key according to claim 6 and further characterized
in that said at least one first movable pin element (40,
180) is selectably configured to define part of a key
combination.

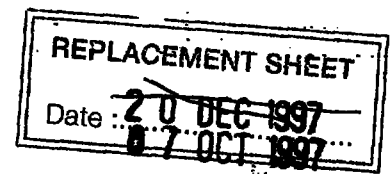
20 9.- A key according to claim 6 and further characterized
in that said first and second key combination surfaces are
laterally offset one from the other and wherein said first
and second movable pin elements (40, 180) are laterally
offset one from the other.

25 10.- A key according to claim 6 and further characterized
in that said at least one first movable pin element (40,
180) is retained within the elongate shaft portion at a
location along said first keyway guide axis so that it
cannot protrude from said second side surface (30).

30 11.- A key according to claim 7 and further characterized
in that at least one second movable pin element (40, 180)
is retained within the elongate shaft portion (26) at a
location along said second keyway guide axis so that it
cannot protrude from said first side surface (28).

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12.- A key according to claim 7 and further characterized in that at least one second movable pin element (40, 180) is selectably configured to define part of a key combination.

5

13.- A lock and key combination, the key comprising:

10 a generally elongate shaft portion (26) extending along a shaft axis and defining first and second generally flat oppositely directed side surfaces (28, 30), joined by edge surfaces narrower than said side surfaces (28, 30), said first side surface (28) defining a first key combination surface and having formed thereon elongate keyway guides (34, 184) extending at least partly along a first keyway guide axis, parallel to said shaft axis and a row of key cuts (32, 18) which define a key combination, arranged along said first keyway guide axis; and at least one first movable pin element (40, 180) retained within the elongate shaft portion,

20

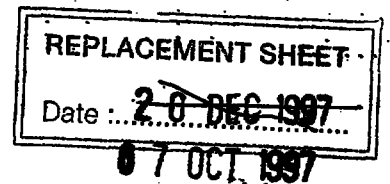
the key characterized in that

25 the at least one first movable pin element (40, 180) extends along a first movable pin axis, located along said first keyway guide axis, said movable pin axis being perpendicular to said keyway guide axis, wherein said pin element (40, 180) extends from said first side surface (28) to said second side surface (30) and is displaced axially along said first movable pin axis from said second side surface (30) inwardly towards said first side surface (28), such that when said at least one first movable pin element (40, 180) is recessed with respect to said second side surface (30) it protrudes outwardly from said first side surface (28) along said row of key cuts (32, 182), the lock comprising:

35

a housing (122); a plug (124) disposed in the

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housing, arranged for rotation relative thereto and defining a keyway (126); a first plurality of chambers (128) formed in the housing and a second plurality of chambers (130) formed in the plug on one side of the keyway and being arranged such that each one of the first plurality of chambers (128) extends coaxially with a corresponding one of the second plurality of chambers (130), when the plug is in a first rotational orientation relative to the housing;

10 wherein first pin assemblies (132) are disposed in the first plurality of chambers (128) and second pin assemblies (136) are disposed in the second plurality of chambers (130), said first pin assemblies (132) each being displaceable along a first pin assembly axis and said second pin assemblies (136) each being displaceable along a second pin assembly axis;

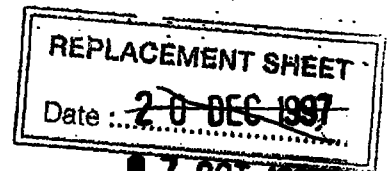
the lock characterized in that

20 a third pin assembly (140) is disposed in the plug on a side of the keyway (126) opposite to that of the second pin assemblies (136) and facing one of the second pin assemblies (136) and is operative to urge said at least one first movable pin element (40, 180) axially outwardly from the key (24) into engagement with one of the second pin assemblies (136), said third pin assembly (140) being displaceable over a third pin assembly displacement axis which is coaxial with one of said second pin assembly axes.

30 14.- A lock and key combination according to claim 13 and wherein said third pin assembly (140) comprises a spring loaded pin (154).

35 15.- A lock and key combination according to claim 13, the key characterized in that said at least one first movable

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pin element (40, 180) is retained within the elongate shaft portion (26) at a location along said first keyway guide axis so that it cannot protrude from said second side surface (30).

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