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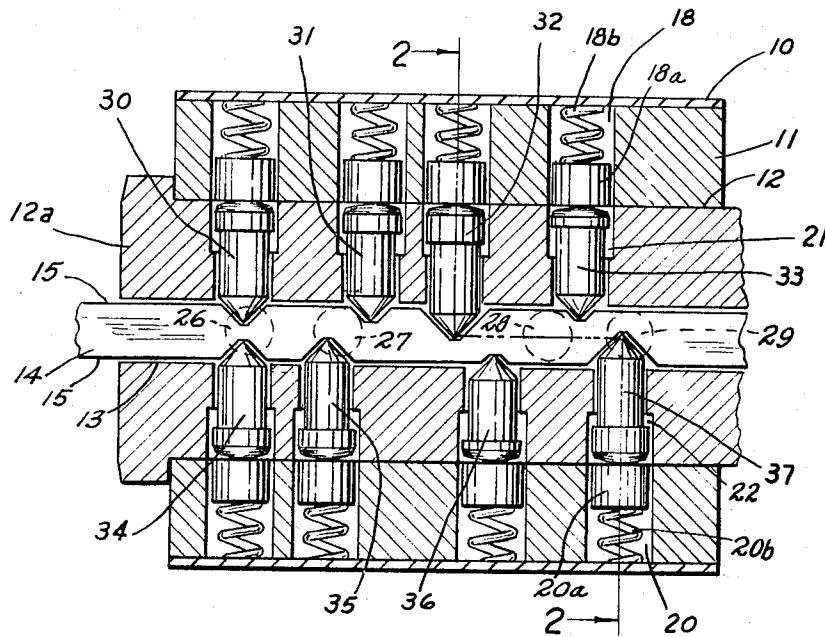
C. A. BAUER

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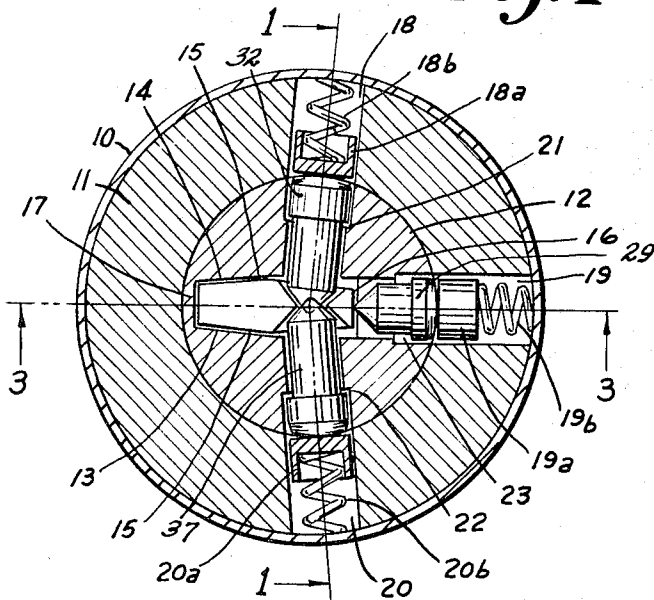
PICK-RESISTANT LOCK AND KEY THEREFOR

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**Fig. 1**



**Fig. 2**

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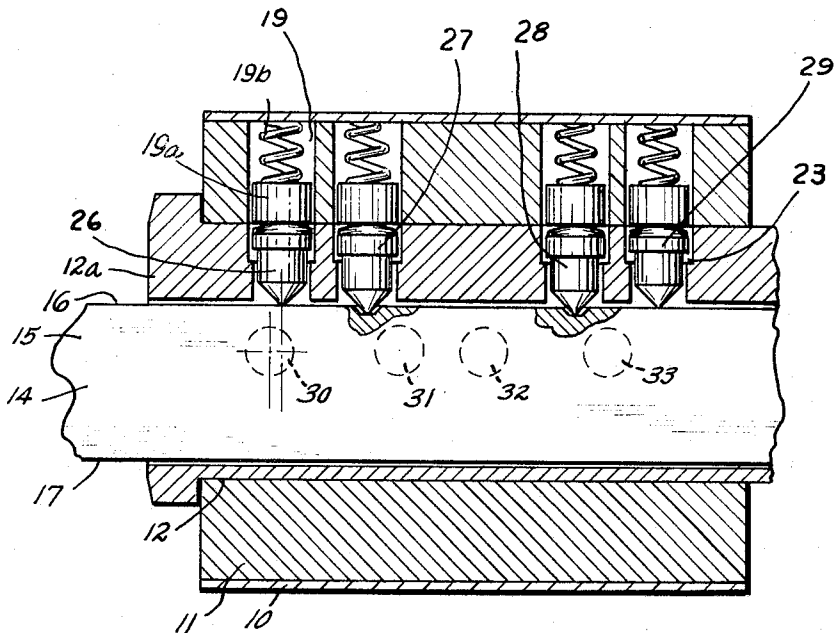
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PICK-RESISTANT LOCK AND KEY THEREFOR

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*Fig. 3*

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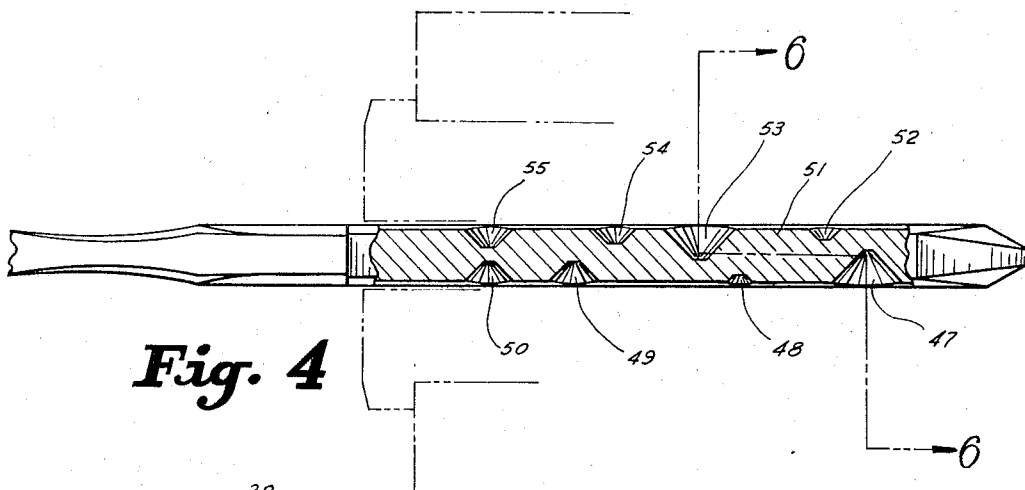
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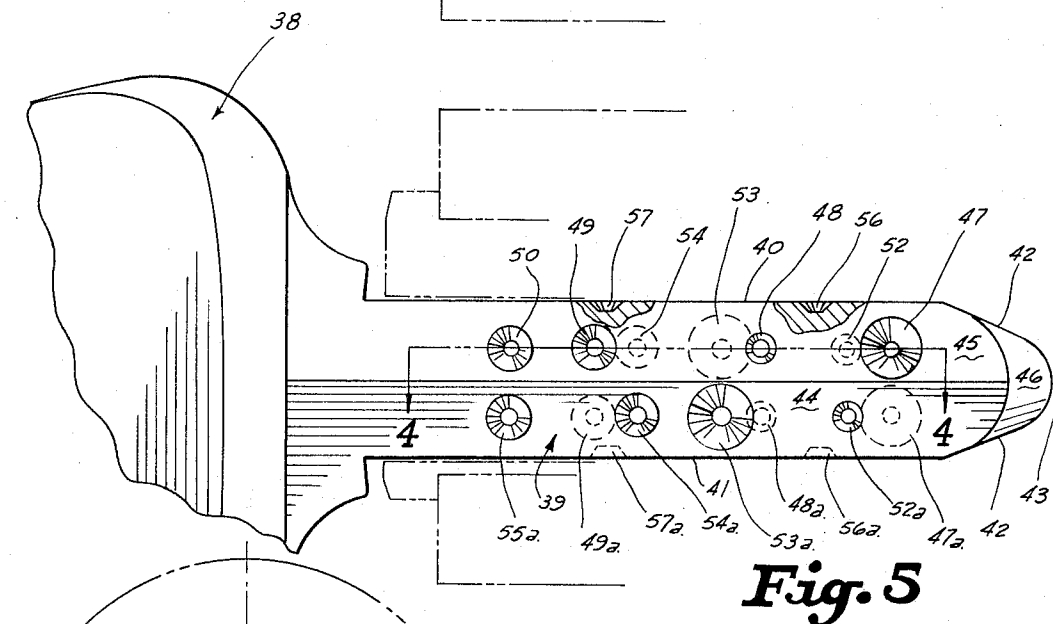
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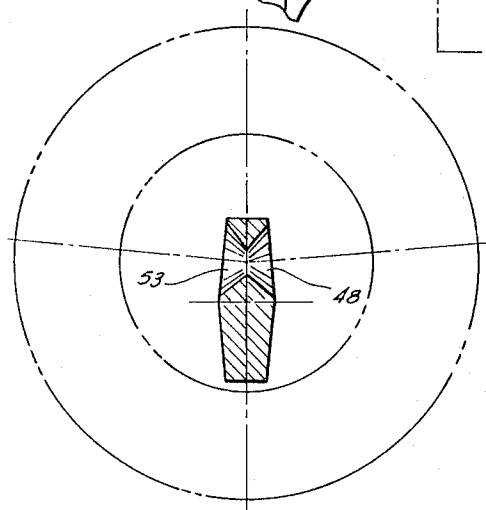
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**Fig. 4**



**Fig. 5**



**Fig. 6**

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**PICK-RESISTANT LOCK AND KEY THEREFOR**  
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15 Claims. (Cl. 70-358)

This application is a continuation-in-part of application Serial No. 399,165, filed September 25, 1964, now abandoned, entitled Pick-Resistant Lock.

This invention relates to a pick-resistant lock and a key therefor, and relates more particularly to a lock of the aforesaid character having features which make the lock extremely difficult to pick. While the principles of the lock are susceptible to use with keys having different characteristics, the key developed for this lock has particular characteristics which make it an improvement over other keys susceptible for use with a lock employing the aforesaid principles, and the key is considered a part of the invention.

One feature of the lock is that it may employ a plurality of rows of tumbler pins, each biased inwardly in the key barrel by one of a plurality of driver pins normally precluding rotation of the barrel in the barrel-housing cylinder but being adapted to be raised by the proper key to present a shear line (wherein neither the driver nor the tumbler prevents rotation of the barrel) so that the barrel may be rotated in the cylinder to draw the bolt of the lock and wherein at least one tumbler of one row extends inwardly in the barrel to a point beyond that which at least one tumbler pin of another row in angular relation to the first row extends, so that these tumbler pins are in effect in overlapping relationship when the key is in the lock and the aforementioned shear line is effected.

Another feature of the lock of the type having a plurality of rows of tumbler pins wherein the rows are angularly arranged relatively to one another is the provision of a tumbler pin of one row offset with reference to a tumbler pin of another row a distance less than one half its diameter, the tumbler pins having tapered inner ends and being of different lengths and the shorter of the pins being rearwardly of the other.

Moreover, it is contemplated that the lock may have three rows of tumbler pins angularly arranged with one another, wherein one pin of each of the first and second rows of tumbler pins is arranged in the aforementioned overlapping relationship to the other and wherein at least one pin of the third row is offset in the aforesaid manner relatively to a pin of either (or both) the aforementioned first or second row. Such a lock is extremely pick resistant.

In picking a lock, an expert in this field will attempt to establish which of the tumbler pins has the tightest fit in the lock, and the picker will raise this pin tumbler first. At the same time torque is applied to the key barrel so that, when a shear line is reached, the key barrel may be rotated slightly to present a "ledge" on which the driver pin may rest so as to prevent its reentry into the barrel. The lock picker may then proceed to pick the remaining tumbler pins in similar fashion. After picking one pin, he will exercise care not to disturb that pin again.

It is believed that conventional picking tools would not serve the purpose of picking the lock embodying the invention. It will be apparent from the foregoing that the lock picker is not permitted straight-line access to pins which he must pick in order to rotate the barrel sufficiently to draw the bolt of the lock. It is also believed that a sinuous tool would be required to pick the lock,

and it may be noted here that the spacing of the tumbler pins longitudinally of the barrel may be infinite or nearly so, so that the convolutions of a picking tool might have to accord with the longitudinal disposition of tumbler pins in a particular barrel and cylinder assembly. It may also be noted here in this connection that the so-called overlapping pins, when presenting a shear line, must extend a substantial distance into the keyway. The same is true of the longer of the two pins offset relatively to one another in the manner indicated above. These features, as previously indicated, make access to certain pins which must be picked extremely difficult, at best, without disturbing pins which have been previously picked. The combination of features makes the lock very pick resistant.

It is to be noted that none of these pins is required to be "split" in the technical sense. A split pin is often employed for master-keying purposes and includes two or more key tumblers driven by a spring-biased driver pin, the "split" having shear lines therebetween to permit turning of the key barrel as by a master key for authorized entry.

While the lock of the present invention does not require the use of "split" pins, it lends itself very well to master keying. It may also include a so-called closed keyway. The positions of the key tumblers in any given row may vary considerably with respect to each other and also with certain tumblers of other rows of the tumblers in the lock. However, as previously indicated, the relationship of certain key tumblers with respect to one another is critical in the invention, not only their relationship to one another, but the relative depth to which at least certain key tumblers must extend into the keyway when a shear line is presented, as previously described.

The so-called closed keyway does not require that the keyway extend through the periphery of the key barrel, and in fact it does not in keyways of this type. Such keyways are well known in the industry.

Still another feature of the invention is the provision of a key having a body portion for reception in the key barrel, which portion is hexagonal throughout almost its entire length, extending from the tip portion thereof to the bow portion of the key fixed to the other end of the body. The body is symmetrical about its longitudinal axis. For cooperation with the three rows of tumbler pins, the key is provided with recesses or pits which may be milled in the key blank in an infinite number of positions along that part of the body which is received in the barrel, for cooperation with the pin tumblers, but, of course, being located in accordance with the location of the tumblers. The means defining the pits of each row in the body portion have their axes arranged relatively to the axes of the pits defined by the body in the neighboring row at an angle of less than 90 degrees so that in a lock embodying the invention and including three rows of pits for reception of tumbler pins, so-called "catches" will be prevented, that is, unintended reception of a tumbler pin in a pit as the key barrel is rotated by the proper key to draw the bolt of the lock.

As will be more apparent hereinafter, the key for a lock having three rows of tumbler-receiving recesses or pits therein may have one row formed on a relatively narrow planar face of the hexagon which is, in effect, the upper edge of the key. The other two rows are arranged at opposite sides of the key, that is, on those faces of the hexagon to either side of the upper edge referred to above.

A further advantage of the key is that the pits formed in the key blank as aforesaid on three faces or what is, in effect, one half of the key body, may be duplicated on the other three faces or half of the body so that the key may be inserted in the barrel in a reversible manner, thus making it extremely easy to insert the key in the barrel. One

does not have to look at the key to ascertain "whether the right side is up" before inserting it in the barrel or feel the body portion of the key to ascertain this. One needs only to grasp the bow in the usual manner so that it is vertically arranged in the user's fingers and then insert the key into the lock. Hence, the construction of the key tends to eliminate so-called fumbling with keys.

Moreover, the tip of the key may be tapered in a manner to still further facilitate insertion of the key into the barrel, the taper being formed for cooperation with all six sides of the key. The polygonal cross section of the body facilitates the centering of the key with respect to the means defining the keyhole in the barrel and, therefore, makes easier the alignment of the pits with the tumblers.

Also of significance is the fact that the aforementioned means provided by the key body defining the pits provides pits which are truncated cones for cooperation with complementally tapered pin tumblers. The conical side wall structure of the pits facilitates the entry of the pin tumblers therein to the full depth of the pits which, as previously indicated, are flat bottomed. The pits are flat bottomed to accurately control the positions of the pin tumblers with reference to the key barrel and the cylinder.

Still another advantage is that the particular key of the invention may be relatively light in weight and without bulk and yet provide sufficient material in the key body to give the necessary strength of this portion of the key, and sufficient material so that the pin tumblers may be received in the key to the desired depth.

In view of the foregoing, it is believed apparent that one object of the invention is to provide an improved pick-resistant lock and a key therefor, which lock and key may incorporate some or all of the features mentioned above but does not require the construction and positioning of one pin tumbler with respect to one another, as indicated above, and some aspects of the key previously described. A further object of the invention is to provide a key having optimum characteristics for cooperation with such a lock.

In the drawings:

FIG. 1 is a fragmentary view illustrating a lock cylinder and barrel in longitudinal section taken on line 1—1 of FIG. 2, embodying the invention and showing two rows of pin tumblers in solid lines and a third in broken lines;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 5 and illustrating a somewhat modified form of key;

FIG. 5 is a fragmentary view illustrating the key of FIG. 4 as viewed at right angles thereto; and

FIG. 6 is a sectional view taken on line 6—6 of FIG. 4.

In the drawings, the numeral 10 denotes an elongated hollow cylindrical member or sleeve for illustrative purposes which snugly receives an elongated cylindrical key barrel housing 11. Received within the latter is a key barrel 12 (FIG. 2), which in the illustrated form, is concentric therewith, and has what is known as a "closed keyway" indicated at 13 in the last-mentioned view. The outer end of the key barrel is indicated at 12a and the inner end may have the usual rollback, not shown. The keyway receives in the illustrated form a hexagonal key 14. The key 14 is shown in the tumbler-releasing position, as will be explained in detail hereinafter. For the purpose of this description of the form of the invention of FIGS. 1 through 3, it is sufficient that the key be considered, in effect as having three sides, two opposite ones of which are indicated at 15, with a side therebetween indicated at 16 and in a sense the equivalent of an upper edge portion of a conventional key. However, as will be more apparent hereinafter, the key might be cylindrical or triangular in cross section.

As best shown in FIG. 2, the cylinder 11 is provided

with three longitudinal series of bores extending there-through, one series being indicated at 18, the second at 19 and the third at 20. In each bore in series 18 there may be a driver pin 18a urged toward the key barrel by a spring 18b coacting between the last-mentioned pin and the sleeve 10. Each bore 19 has a similar pin 19a and a spring 19b. In similar fashion each bore 20 contains a similar pin 20a and spring 20b. As indicated in FIG. 2, the series of bores 18 and 20 in the cylinder do not have their axes arranged at an angle of 180 degrees to each other but at a somewhat smaller angle. The series 19 of bores formed within the cylinder have their axes disposed at an angle of less than 90 degrees with respect to both the series 18 and 20.

As best shown in FIG. 2, the series 18 of bores formed on the cylinder 11 are aligned with a series of counter-bored openings 21 formed in the key barrel 12 when the barrel is in the angular position shown, and in similar fashion the series 20 of bores formed in the cylinder 11 are aligned with a series 22 of counterbored openings in the key barrel when the barrel is in the last-mentioned position. When the barrel is in the last-mentioned angular position thereof with reference to the cylinder, the series of bores 19 are aligned with counterbored openings 23 in the key barrel.

It should be noted here that the spacing of each bore in the series 18, 19 and 20 may vary with respect to every other bore in the same series, if desired, that is, along the length of the cylinder 11, provided that these series of bores are alignable with the corresponding bores in the key barrel and are in the hereinafter-described relationship in the spacing of at least certain bores in the lock. The pin tumblers should have end portions tapered complementally with respect to the tapered side walls of the aforementioned pits in the key, which pits receive the tumblers. The extreme tips of these pins may be flattened to present surface areas substantially less than, say approximately half, the surface area of the flat bottoms of the pits.

As shown in the drawings, the counterbored openings 21 formed in the key barrel received key tumbler pins 30, 31, 32 and 33 (FIG. 1) having their substantially pointed inner ends extensible in the keyway, each having a shoulder formed thereon cooperating with the corresponding counterbore to limit inward movement of the key tumbler pin when the key is removed, and each having the position shown when the proper key is inserted in the lock wherein at least certain tumbler pins extend a substantial distance into the keyway.

These key tumbler pins cooperate with corresponding ones of the driver pins 18a. For convenience's sake, the bores 21 in the barrel are counterbored at the same depth and the depth of the shoulders on the pins is varied to limit the inward extension of the key tumbler pins instead of varying the depth of the counterbores for determining the inward extension of the tumbler pins upon removal of the key. In similar manner the counterbored holes 23 in the key barrel receive shouldered key tumbler pins 26, 27, 28 and 29 (FIG. 3) extensible into the keyway and biased in that direction by corresponding ones of the driver pins 19a, the inward extension of these tumbler pins being similarly limited when the key is removed.

Also in similar fashion, the counterbored openings 22 in the key barrel receive key tumbler pins 34, 35, 36 and 37 cooperating with their respective driver pins 20a when the key barrel is in the angular position shown in the drawings.

When the key 14 is removed and an attempt is made to pick the lock, the picker to pick the pin tumblers 30 and 34 (FIG. 1), which are urged toward one another in angular nosing relationship, must contend with the pin tumbler 26 which may be displaced rearwardly of the aforementioned pins by a distance, with reference to its axis, which may be as short as approximately  $\frac{1}{5}$  of the diameters of the bodies of either or both the pins

30 and 34 but greater than the last-mentioned fraction as shown in the drawings for illustrative purposes, thus making it exceedingly difficult to pick these three pins to effect shear lines between the cylinder and the barrel.

In this connection it should be noted that the reference to the displacement of the pin tumbler 26 indicates its position relatively to the axis of either pin 30 and/or pin 34. Pin tumbler 35 is also offset axially only a slight distance with reference to pin tumbler pin 27, as shown in FIG. 1.

It is important to note that when the key tumbler pin 32 is in a position to effect a shear line (FIG. 1), it projects into the keyway a distance beyond the point to which the key tumbler pin 37 projects into the keyway when effecting a shear line so that these pins overlap, in effect, as indicated in FIG. 2, thus inhibiting access to tumbler pins 36, 28 and 33 (FIG. 1) as the picking tool is moved rearwardly in the lock, that is, without disturbing tumbler pin 32. It may be noted that the aforementioned tumbler pin 37 has its axis offset relatively to the axis of pin tumbler 29 and that the axis of the former is disposed forwardly of the axis of the latter in the manner similar to that previously described with reference to axially offset pin tumblers. Note (FIG. 3) that tumbler pin 29, as well as tumbler pin 26, may present a shear line when urged outwardly in the barrel by face 16 of the key. It will be understood from the drawings and the foregoing description that the body of the key 14, which is received in the key barrel, is provided with recesses or pits on faces 15 and 16 thereof to receive at least certain of the tumbler pins of each of the three rows thereof. Tumbler pin 28 may have the relationship to tumbler pins 36 and 33 and the key shown in FIGS. 1 and 3 of the drawings. Tumbler pins 27, 31 and 35 may have the relationship shown in the last-mentioned views.

It is believed that the particular angularity of the rows of pin tumblers relatively to one another tends to even further increase the pick resistance of the lock. However, the angularity of the pin rows serve other purposes, as previously indicated.

It should be noted here that the sleeve 10, the cylinder 11 and the barrel 12 are not shown in relationship to any closure or lock face plate suitable for mounting on a closure. Normally the sleeve, cylinder and barrel would be positioned with reference to a closure or face plate when rotated 90 degrees counterclockwise from the position shown in FIG. 2.

The key shown in FIGS. 4, 5 and 6 is in some respects similar to the key 14 previously described. It is provided with a bow portion indicated generally at 38 as to which I make no claim concerning its design or configuration. The bow of the key is the portion which is grasped by the user for insertion of the key into the lock to draw the bolt by rotation of the key barrel. The key barrel may be provided with the usual rollback, not shown, for bolt-drawing purposes. Integrally formed with the bow portion 38 is the body portion of the key indicated generally at 39, having the characteristics previously described and some additional characteristics. The body portion of the key is hexagonal throughout the major portion of its length with faces 40 and 41 thereof of less width than the remaining four faces of the hexagon. As will be more apparent hereinafter, either the face 40 or the face 41 may face upwardly for reception in the lock, thereby making the key reversible, the body portion 39 being symmetrical about its longitudinal axis when in the form of a key blank.

As previously indicated, the entire peripheral part of the tip portion of the body is tapered to facilitate insertion of the key in the lock. To this end the tip portion is provided with substantially planar tapered surfaces 42 merging into an interconnecting surface 43 formed on a radius. Planar surfaces 44 and 45 of the hexagon (FIG. 4) adjoining one another merge with a tapered surface 46

which is preferably slightly rounded. It will be understood that the surfaces 44 and 45 are duplicated on that portion of the key remote from, but equivalent to, those shown in FIG. 5 and merge with the tip portion in similar fashion.

The body portion 39 of the key has means providing recesses or pits, formed as by milling a suitable key blank, indicated at 47, 48, 49 and 50, receiving respectively tumbler pins 37, 36, 35 and 34. These pits all have flat bottoms. In the form of the lock previously described, the pins are all of the same diameter and the aforementioned pits have bottoms of equal diameter.

However, as the pits have tapered side wall surfaces substantially complementally formed to the taper of the tumbler pins, the pits vary in diameter according to the depth to which the pits extend into the body portion 39 of the key. The flat bottoms of the pits cooperating with the complementally formed tumblers inhibit binding of the latter in the pits and the clearance between the tip portions of the tumbler pins and the side walls of the pits is preferably approximately .005 of an inch to further prevent binding of the tumbler pins in the pits. As will be readily understood from the foregoing description of the varying extent to which the tumbler pins extend into the keyway when a shear line is provided between the barrel and the cylinder, it will be understood that the pits are of different depths.

As shown in FIG. 4, the face 51 of the hexagon, which may be defined as opposite the face 45, is provided with means defining pits 52, 53, 54 and 55 for reception of tumbler pins 33, 32, 31 and 30 respectively, the pits being generally similar to those previously described formed in the face 45 of the key body.

Generally similar pits 56 and 57 are formed on the uppermost face 40 of the hexagonal body portion of the latter, as shown in FIG. 5, to receive pin tumblers 28 and 27 respectively. This face 40 of the hexagon is narrower than the faces 44 and 45, as previously indicated and, as to disposition with reference to the bow portion of the key, is the equivalent of the upper edge of a conventional key.

It will be noted that, as illustrated, the planar surface 40 of the key body, which is the equivalent of the surface 16 of the key 14, coacts with the pin tumblers 26 and 29, the latter being offset rearwardly with reference to the rearmost overlapping pin 37 a distance less than one half the diameter of the pin 37. From the foregoing, it will be appreciated that the pits 47 and 53 have a combined depth which is greater than the distance between the planar surfaces in which they are formed, if this distance is measured axially of the means defining the pits and not across the body in a straight line, bearing in mind that these planar surfaces are not necessarily parallel but may have a taper as shown.

In order that the key may be reversible for insertion in the lock, that is, with either the surface 40 or 41 uppermost, the pits 52, 53, 54 and 55 are duplicated as at 52a, 53a, 54a and 55a in the face 44 of the hexagon, and the pits 56 and 57 are duplicated as at 56a and 57a in the face 41 of the hexagon. It will be understood from the foregoing that the pits 47, 48, 49 and 50 are duplicated in the face of the hexagon generally opposite the face 44. The advantages of the key construction detailed in a foregoing portion of the specification need not be repeated here.

It will be understood from the foregoing that the invention in a lock and key therefor may take other forms than those shown in the drawings and described above, and that the lock and key are susceptible of various changes in details without departing from the spirit of the invention and the scope of the appended claims.

What I claim is:

1. In a pin tumbler lock, a housing of elongated form providing means defining at least three series of longitudinally arranged driver pin bores, extending transversely of

the housing in spaced angular relation to one another a key barrel within the housing having means defining a keyway extending through the outer end thereof and rotatable in the housing by a key, said barrel having means defining tumbler pin bores therein extending from the keyway through the periphery of the barrel and alignable axially with said bores formed in the housing when the barrel is in one angular position relatively to the housing, and three series of pin tumblers in said barrel bores, each of which pins is urged inwardly toward the keyway, having a tapered inner end, for cooperation with the key when the barrel is in the last-mentioned angular position thereof by a companion spring-biased driver pin in its housing bore and presenting a shear line between the barrel and the housing when the key is in the barrel, one tumbler of one series extending beyond the point to which a tumbler of a second series extends into the keyway so that the last-mentioned tumblers are in effect in overlapping relationship when the shear line is presented, one tumbler pin of the third series extending into the keyway when the key is removed from the barrel and having its axis spaced rearwardly from the axis of the innermost overlapping pin a distance less than one half the diameter of the last-mentioned overlapping pin to inhibit picking of the lock.

2. A pin tumbler lock as defined in claim 1 wherein intermediate of said overlapping pins another tumbler pin of said one series extends into the keyway when a shear line is presented by the pin between the barrel and the housing.

3. A pin tumbler lock as defined in claim 1 wherein another pin tumbler of said second series extends into said keyway intermediate said overlapping pins when the pin presents a shear line between the barrel and the housing.

4. A pin tumbler lock as defined in claim 1 wherein another tumbler pin of the third row extends into the keyway intermediate the overlapping pins when the pin presents a shear line between the barrel and the housing.

5. A pin tumbler lock as defined in claim 1 wherein another tumbler pin of each series extends into the keyway intermediate said overlapping pins when the key is removed from the barrel.

6. A pin tumbler lock as defined in claim 1 wherein the distance between said axes ranges between approximately  $\frac{1}{3}$  of one half the diameter of the last-mentioned overlapping pin and approximately but less than one half the diameter of this pin.

7. A pin tumbler lock as defined in claim 1 wherein said pin having its axis disposed rearwardly of the innermost overlapping pin is substantially flush with the inner end of the barrel bore receiving the pin when the pin presents a shear line between the barrel and the housing.

8. A pin tumbler lock as defined in claim 1 wherein said third series is disposed intermediate said one series and said second series.

9. A pin tumbler lock as defined in claim 7 wherein each of the three series of tumbler pins is arranged angularly with respect to a neighboring series at an angle of less than 90 degrees.

10. In a key for a pin tumbler lock of the type having three series of tumbler pins, arranged angularly relatively to one another, the pins being extensible into the keyway of the lock, wherein at least one pin of each of a first and second of the series is arranged in overlapping relationship to the other when the key is in operative position in the lock and a pin of the third series having its axis positioned with reference to the face of the lock rearwardly of the axis of the rearmost overlapping pin a distance less than one half the diameter of the last-mentioned pin, the improvement wherein the key is provided with a body which cooperates with the pin tumblers, the body having means coacting with the first and second pin series including pits in first and second planar surfaces of the body, certain of which have a combined depth greater than the distance between said first and second planar surfaces to receive the overlapping pins, said first and second planar surfaces being opposite the first and second pin series respectively, and the body also having means including pits in a third planar surface thereof opposite the third pin series receiving at least certain of the pins of the third series and longitudinally offset with reference to the first-mentioned pits, the last-named means coacting with said pin of the third series.

11. A key as defined in claim 10 wherein the body of the key is of substantially uniform cross section throughout substantially its entire length.

12. A key as defined in claim 10 wherein the distal end portion of the body has tapered surfaces merging with each of said planar surfaces.

13. A key as defined in claim 10 wherein the body is polygonal in cross section throughout substantially the greater part of its length.

14. A key as defined in claim 13 wherein two of said planar surfaces are wider than the third.

15. A key as defined in claim 13 wherein the body is provided with means defining pits of varying depth in said three planar surfaces opposite corresponding ones of said three pin series, and wherein said polygon has at least six sides, and means defining duplications of said pits in three other planar surfaces of the body so that the body may be reversed with reference to said pin series.

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