NOVEL LOCK WITH TOOLS AND METHOD OF FORMING AND FIXING THE LOCK

Set comprising a tumbler lock housing, a jig, and a pin stopper extractor tool; the tumbler lock housing includes a cylinder rod for a cylinder, and a block comprising chambers, each chamber extending substantially perpendicularly to the cylinder rod and serves to receive a pin stopper; the pin tumbler lock housing further comprises a secondary access hole bored into each chamber from a side of the block providing access to a jammed pin stopper in the chamber, facilitating unjamming of the chamber; the jig comprises a tumbler-lock-housing receiving cavity for receiving a tumbler lock housing and at least one guide channel for guiding a tool to bore the at least one secondary access hole into the at least one chamber; the pin stopper having a tapped hole therein and the pin stopper extractor tool having a threaded tip to engage the tapped hole to extract the pin stopper.

Fig. 2
NOVEL LOCK WITH TOOLS AND METHOD
OF FORMING AND FIXING THE LOCK

FIELD OF INVENTION
The present invention relates to the field of locks. In particular, the present invention relates to pin tumbler locks and to locksmith's tools.

BACKGROUND OF INVENTION
A pin tumbler cylinder lock is a common type of lock mechanism used in mortice locks and the like, in which pins of varying lengths must be aligned in order to allow a lock plug cylinder to rotate. The pin tumbler cylinder lock comprises a housing having a cylindrical bore in which the lock plug cylinder is removably inserted. The lock plug cylinder contains a plurality of openings that are initially positioned beneath and aligned with a plurality of chambers in the housing. Each pin chamber contains a pin stack, which consists of at least: a key pin, located entirely within the lock plug cylinder; a driver pin, located partially within the cylinder and partially within its chamber, for preventing the cylinder from rotating; and, a compression spring, located within the chamber, between the key pin and driver pin. When a correct key is inserted into the lock plug cylinder, the peaks and valleys of the key raise and lower the pin stack, so as to situate the driver pins entirely within the chambers, detaching the cylinder from the housing, thereby allowing the lock plug cylinder to rotate. In more complicated locks, additional pin stack elements may be present, such as spacer pins, for example.

Pin tumbler locks, however, are susceptible to malfunctions. One example of a common malfunction, known as a chamber jam, is where one or more components of the pin stack get stuck within one of the chambers of the lock housing. Often the only way of repairing such a jam is to remove the lock plug and then remove the pin stack components through the empty cylindrical bore. However, due to the small size of the bore, and to the fact that the chamber is perpendicular to the bore, it is difficult to remove the pin stack components from the chamber. Consequently such locks are often discarded and replaced in their entirety to avoid the difficulties involved with attempting their repair.

US 5,921,122 to Lin, discloses a device for preventing the upper pin tumblers from falling while replacing a lock plug. A lock is described therein comprising a number of longitudinally spaced holes in communication with the lower end of an
associated upper chamber. A fork device having a number of branches is removably insertable into an associated hole to support the associated upper pin tumbler during replacement of the lock plug. The longitudinally spaced holes are bored in the housing perpendicularly to the associated chamber (see Fig. 5 thereof). Also, it will be noted that the holes must intersect with the shear (or, split) line of the lock for separating the upper pin tumblers from the lower pin tumblers.

US 5,276,951 to Gluszek describes a tubular lock puller for pulling the inner cylinder (or, lock plug) from the cylindrical bore of a lock housing. The tool comprises a cylindrical housing having a threaded main shaft having a front section with resilient fingers, which are radially compressible for insertion into the annular key passageway of the lock. Once inserted, the fingers return to their original position and engage the inner rim of the lock cylinder with their tips. A second shaft is slidable within the main shaft and carries a locking cup that retains the fingers in the lock engaging position. A threaded nut on the main shaft is rotated to withdraw the main shaft and forceably pull the inner cylinder from the lock.

US 6,601,277 to Swanson, discloses a puller tool for bolt seals, for separating a security pin from a mated female part. The tool comprises an outer sleeve having an axially extending passage, a radial detent shoulder about the passage at one end of the sleeve, an actuating bolt including a threaded shank axially insertable into the passage and an enlarged head that engages the detent shoulder to prevent further insertion of the actuating bolt into the passage, and a puller member insertable into the passage from an opposite end of the sleeve.

It is an object of embodiments of the present invention to provide novel cylinder locks configured in such a manner as to enable chamber jams to be easily repaired;

It is a further object of embodiments of the present invention to provide a method of retro-converting a conventional cylinder lock of the prior art into a novel cylinder lock configured in such a manner as to enable chamber jams to be easily repaired.

It is yet an additional object of embodiments of the present invention to provide a tool for fabricating the novel lock of the present invention.
It is yet another object of embodiments of the present invention to provide a device for removing a jam in the chamber of a lock housing.

It is yet another object of embodiments of the present invention to provide a tool for holding a lock housing and for facilitating retro conversion thereof.

It is yet a further object of embodiments of the present invention to provide a tool for removing the pin stopper from its chamber in a lock housing.

It is yet another object of embodiments of the present invention to provide a device that is inexpensive to manufacture and easy to operate.

Additional objects and advantages of the present invention are described in detail herein below.

**SUMMARY OF INVENTION**

The present invention is directed to a set comprising: (i) a tumbler lock housing; (ii) a jig, and (iii) a pin stopper extractor tool, wherein the tumbler lock housing includes a cylinder rod for a cylinder and a block comprising at least one chamber, each chamber extending substantially perpendicularly to the cylinder rod and serving to receive a pin stopper, wherein the pin tumbler lock housing further comprises a secondary access hole bored into each chamber from a side of the block, each secondary access hole to provide access to a jammed pin stopper in the chamber, to facilitate unjamming of the pin stopper; wherein the jig comprises a tumbler-lock-housing receiving cavity for receiving a tumbler lock housing and at least one guide channels for guiding a tool to bore the at least one secondary access hole into the at least one chamber, and wherein the pin stopper has a tapped hole therein and the pin stopper extractor tool has a threaded tip for engaging the tapped hole, thereby to extract the pin stopper.

In accordance with a first aspect, there is provided a pin tumbler lock housing comprising a cylindrical bore and a block, the cylindrical bore adapted to receive a lock plug cylinder, and further comprising a series of chambers located in said housing running parallel to axis of said cylindrical bore, wherein each chamber in said series extends radially from said cylindrical bore through said block, and each of said chambers is adapted to receive a pin stack, and an inner end of each chamber opens to said cylindrical bore and an outer end of each chamber opens to...
the outside of said housing, wherein at least one secondary access hole is provided through the housing and into at least one chamber from a side of the block, each secondary access hole to provide access to a jammed pin stopper in the chamber, to facilitate unjamming of the pin stopper.

5 Preferably, each of said secondary access hole enters said chamber at an angle.

Preferably each chamber is provided with a secondary access hole for aiding unjamming of a tumbler in said chamber

Optionally, two secondary access holes enter the chamber.

10 Preferably each secondary access hole is angled at an angle of more than 90 degrees to the chamber.

A second aspect of the invention is directed to providing a jig for forming a series of holes in the housing, wherein said jig has a body comprising a cavity for receiving said housing therein, and further comprising a first series of guide channels running longitudinally along said body, wherein each guide channel in said first series is bored through said body.

Optionally, a second series of channels is provided along a side of said body, and wherein said channels couplingly connect outside of said jig with said receiving cavity.

20 Typically, a first series of channels guides a boring tool to bore a series of access holes in a lock housing within the cavity such that each of said first series of access holes provide access to chambers in said lock housing.

Optionally, a second series of channels is provided for guiding a tool to bore a second series of access holes in said housing.

25 In one embodiment, the jig comprises a front end for receiving a lock housing, and an end stopper for preventing said housing from extending past a back end of the jig.
 Optionally, the end stopper comprises a slab fixedly abutting the back end of the tool.

 Preferably the jig further comprises a holding means for fixedly maintaining the housing within the receiving cavity.

 Optionally, the holding means comprises at least one threaded through hole and a corresponding screw for screwingly inserting into said through hole such that a tip of said screw presses said housing against an inside wall of the receiving cavity of said jig.

 A further aspect of the invention is directed to providing a method of forming a series of holes in the lock housing, comprising the steps of: inserting the housing into the tumbler-lock-housing receiving cavity of the jig; aligning said housing within said cavity, and drilling holes through first series of access channels into said chambers.

 Optionally, the aligning step is performed by positioning an end of the housing against back end of the jig.

 A further aspect of the invention is directed to providing a pin stopper extractor tool for extracting a pin stopper from an outer end of a chamber of a cylinder lock housing, wherein said pin stopper comprises a tapped hole in an outer end of said pin stopper facing towards outside of said housing and said pin stopper extractor tool comprises a threaded tip for screwably inserting into said tapped hole, and for removing said pin stopper from said chamber.

 Optionally, the pin extractor tool extractor tool comprises an elongated shaft comprised of: a proximal handle portion; a central portion; and a threaded distal tip; a hollow screw in which said central portion is disposed, said hollow screw comprising: a head portion for gripping and rotating; and a body portion having an external threading; a lock saddle having internal threading for positioning along said body portion of said hollow screw; and, a nut positioned around said distal tip, for preventing said shaft from sliding through said hollow screw; wherein said threaded distal tip for inserting into the hole in the pin stopper.
Preferably, the external diameter of the handle portion is larger than the internal diameter of the hollow screw, to prevent the shaft from sliding through said hollow screw.

Optionally, the proximal handle portion, the central portion and the threaded distal tip of the elongated shaft are manufactured as a single integral component.

Preferably, the central portion of the shaft is freely rotatable within the hollow screw.

In one embodiment, the body portion of the hollow screw has left handed external threading.

**BRIEF DESCRIPTION OF THE FIGURES**

The foregoing and other features of the present invention will become apparent to those skilled in the art to which the present invention relates upon reading the following description with reference to the accompanying drawings, in which:

Fig. 1 is an isometric projection of a prior art tumbler pin cylinder lock;

Fig. 2 is an isometric projection of the tumbler pin cylinder lock of the present invention;

Fig. 3 is a cross-sectional view along the longitudinal axis of the housing of the tumbler pin cylinder lock in accordance with an embodiment of the present invention;

Fig. 4 is a transverse cross-sectional view through a chamber and a hole bored through the housing of an embodiment of the present invention;

Fig. 5 shows a front perspective view of a first side of a tool of the invention that may be utilized for forming a lock in accordance with embodiments of the present invention;

Fig. 6 shows a transverse cross-sectional view of the tool of Fig. 5, taken along the first channel of each of three series of channels;

Fig. 7 shows a back view of the tool of Fig. 5;

Fig. 8 shows a front perspective view of a second side of the tool utilized for assembling a lock in accordance with embodiments of the present invention;
Fig. 9 shows a cross-sectional view of a prior art lock housing situated within the tool of Fig. 6;

Fig. 10 shows the view of Fig. 9, with a priming notch in the housing;

Fig. 11 shows the view of Fig. 9, with a hole bored into the housing via the tool.

Figs. 12a and 12b show an enlarged front view (Fig. 12a) and top view (Fig. 12b) of a pin stopper of the present invention with a hole bored therein;

Figs. 13a, 13b and 13c show an assembled front view of a pin extractor tool of an embodiment of the present invention (Fig. 13a), an assembled side view of the a pin extractor tool of an embodiment of the present invention (Fig. 13b) and an assembled top view of the a pin extractor tool of an embodiment of the present invention (Fig. 13c);

Fig. 14 shows an exploded view of the components of the pin extractor tool in accordance with an embodiment of the present invention; and,

Figs. 15a, 15b and 15c schematically illustrate the process of removing a pin stopper from its chamber using the device of the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

A conventional pin tumbler type, cylinder lock may malfunction in a variety of ways. One example of a common malfunction is when one element of a pin stack becomes jammed within its chamber. When this occurs, a locksmith will typically recommend replacing the tumbler lock instead of attempting to repair it due to the difficulties involved. The present invention provides a novel pin tumbler cylinder lock for enabling a chamber jam to be easily repaired.

Aspects of the invention are directed to a tool and corresponding method for converting a conventional tumbler lock housing into a novel lock housing of the invention, and to a device or tool for fixing the novel lock housing.

The term, "longitudinal side" as used herein with reference to the novel lock housing and the tool for forming the housing, refers to one of the two opposing longitudinal sides of the housing or tool that are parallel with its longitudinal axis, i.e. with what is typically its axis of symmetry. Since housings could be fabricated with different geometries, it will be appreciated that one longitudinal side may comprise more than one surface, i.e. surfaces positioned at different angles with
with respect to the longitudinal axis of the housing or tool, yet for present purposes, may be considered a single longitudinal side.

For clarity of illustration, the pin tumbler cylinder lock referred to herein and related to in the figures, is a single lock, for a single side key entry. It will, however, be understood that other embodiments of the invention relate to double locks having two sided key entry, *mutatis mutandis.*

A conventional prior art pin tumbler cylinder lock housing 10 is shown in Fig. 1 for the purpose of comparison with the present invention. Prior art lock housing 10 comprises a rod 11 with a cylindrical bore 20, therethrough into which a lock plug (not shown) is disposed when the pin tumbler cylinder lock is fully assembled. Extending from the rod 11, is a block 12 into which a series of chambers 30n are drilled., As shown in Fig. 3, within in each chamber 30a-30e a pin stack 140 is disposed when the pin tumbler cylinder lock 10 is assembled.

It should be noted that the orientation of a tumbler cylinder lock within a door is typically (although not necessarily) in a manner such that the cylindrical bore part 11 is vertically above the narrower portion or block 12 of the housing 10. However, for the purposes of clarity in the illustrative depiction of the present invention, the housing 10 is shown oriented in an inverted direction with block 12 over the cylinder rod 11. That as may be, directions towards the cylinder rod are related to herein below as inwards or inner, and directions radially away from the cylinder rod 11 are referred to as outwards, outer, outwardly and the like.

With reference to Fig. 2, an isometric projection of a novel pin tumbler cylinder lock 100 in accordance with a preferred embodiment of the present invention is shown. Pin tumbler lock 100 consists of a housing 110 having a cylindrical bore 120, into which a lock plug (not shown) may be inserted. Housing 110 includes a block 102 containing a series of chambers 130n, where within each chamber 130a-130e a pin stack 146 (see Fig. 3) may be disposed, as with prior art lock housings 10, *mutatis mutandis.* In contradistinction to prior art lock housings 10, it is a notable feature that in the housing of the present embodiment, a second series of holes 112n is bored through a longitudinal side of housing 110 block 102, substantially perpendicular to the bore 120. Each hole 112a-112e is associated with a corresponding chamber 130a-130e, and intersects the chamber, providing an
alternative access route for a tool, to facilitate the unblocking of a jam in the chamber 130a-130e, as described in greater detail herein below.

Figure 3 shows a cross-sectional view through housing 110 of Fig. 2, along its longitudinal axis, illustrating pin stoppers 142a-142e disposed within corresponding chambers 130a-130e. As shown in the figure, the series of chambers 130 runs essentially parallel to the longitudinal axis 121 of cylindrical bore 120. Each chamber 130a-130e radially extends from cylindrical bore 120 through housing 110 block 102. An inner end 132a-132e of each chamber 130a-130e opens to the cylindrical bore 120 and an outer end 134a-134e of each chamber 130a-130e opens to the outside of the housing 110. As mentioned hereinabove, when the lock 100 is fully assembled a pin stack 140 is disposed within each chamber 130a-130e. One chamber 130e is shown in the figure, as an illustrative example, with a pin stack 140 therewithin. Pin stack 140 in chamber 130e comprises a pin stopper 142e a spring 144 and a driver pin 146. It will be appreciated that according to various embodiments of the present invention, additional and/or alternative components may be included in this and other pin stacks, and that not necessarily will there be five chambers and pin stacks.

It should be noted that although the description and figures herein refer to pin stoppers 134, alternatively shaped stoppers, such as ball stoppers, etc., maybe substituted and it will be appreciated that these also fall within the scope of the present invention.

In a conventional prior art tumbler cylinder lock housing 10 (Fig. 1), it is not easy to access the chambers 30a-30e via the cylindrical bore 20. Hence any blockage that occurs in a chamber 30 is very difficult, if not impossible, to clear. It is typically more cost efficient for a locksmith to replace the lock than to charge for the time required to attempt to repair it. As mentioned hereinabove, the present invention enables easy repairing of a tumbler lock malfunction, particularly one that occurs due to a jam of pin stack components (e.g. 140) in a chamber (e.g. 130e). The present invention provides an alternate access to the chamber 130a-130e, instead of through the cylindrical bore 120. This allows the locksmith to easily repair the malfunctioned lock 100, and saves the customer's money in the process.

Fig. 4 shows a transverse cross-sectional view of a housing 100 of a lock of the present invention through chamber 130a and showing a hole 112a of Fig. 2.
Hole 112a as shown, is bored at an angle to the chamber 130a such that an elongated rigid object, for example, a drill bit, may be inserted into hole 112a, and driven towards pin stopper 142a, in order to push the pin stopper 142a out of the opening at the outer end 134a of the chamber 130a. Hole 112a is directed away from inner end 132a of chamber 130a, and towards outer end 134a thereof. The angle of hole 112a with respect to outer end 134a of chamber 130a is greater than 90°, and preferably greater than 100°. The precise angle of hole 112a with respect to outer end 134a of chamber 130a may vary somewhat, with overall lock dimensions and is not required in order to define the present invention. However, the general requirement is to allow an elongated rigid object such as a rod (not shown), to be able to pass through hole 112a and out of outer end 134a of chamber 130a without bending. Alternatively, depending on the material from which the rod is made, as well as the shape of rod, bending may occur in order for the rod to pass through hole 112a and out of outer end 134a of chamber 130a.

Once the pin stopper 142e is removed from its chamber 130e, access to the chamber 130e may be achieved via the outer end 134 of the chamber 130. Repair may be performed, by, for instance, removing the components 142, 144, 146 of the pin stack 140 contained in the chamber 130; either through the outer end 134, or by pushing the components out of the inner opening 132 and removing them via the cylindrical bore 120.

It should be noted that such series of holes 112 may be located on either one or both longitudinal sides of housing 110 block 102. In addition, it is understood that the description and depiction of the features of chamber 112a and hole 130a is illustrative of each of the other chambers 112b-112e and holes 130b-130e, respectively.

With respect to Figs. 5-11, the present invention further provides a jig 200 for fabricating a lock housing 100 of the invention, typically by converting a prior art lock housing 10 into a lock housing 100 of the present invention. An embodiment of the jig 200 is shown in Fig. 5 in a front isometric projection. Jig 200 has a body 210 comprising a tumbler-lock-housing receiving cavity 220 for receiving a conventional prior art tumbler lock housing 10 (Fig. 1), as described herein below. A first series 230 and a second series 240 of channels are bored through body 210
for forming holes (112a-e, see Fig. 2) in housing 100, as further described, hereinbelow.

Also shown in Fig. 5 is an optional third series of channels 250 for aligning with the corresponding openings 134 at the outer ends of the series of chambers 130 of a lock housing 110, as described herein above, when the lock housing is 110 positioned within receiving cavity 220.

Cavity 220 is shown in the figures as having a profile with dimensions adapted for receiving a lock housing 10 (100) as illustrated in Figs. 1 and 2. However, it is understood that cavity 220 may have any suitable profile for receiving a corresponding lock housing.

With reference to Fig. 6, a transverse cross-sectional view of jig 200, through first, second and third channels 230a, 240a, 250a is shown. As shown in Figs. 5 and 6, both first and second series of channels 230, 240 may be positioned along a single longitudinal side 212 of body 210. As best seen in Fig. 6, the inner end 232a of first channel 230a of first series of channels 230 opens to receiving cavity 220, and the inner end 242a of second channel 240a of second series of channels 240 also opens to receiving cavity 220. The outer end 234a of first channel 230a of first series of channels 230 opens to the outside of jig 200, and the outer end 244a of second channel 240a of second series of channels 240 opens to the outside of jig 200.

Still referring to Fig. 6, inner end 232a of first channel 230a of first series 230 intersects and overlaps with the inner end 242a of the corresponding first channel 240a of second series 240. First channel 230a is preferably bored at an angle of 90° or more with respect to the longitudinal axis 202 of the first channel 250a of the third series of channels (250). Second channel 240a is preferably bored at an angle such that an elongated rigid object, such as a drill bit, for example, may be inserted therein, and extended through third channel 250a.

It is understood that the description and depiction of the features of channels 230a, 240a as described herein above are illustrative of each of the other channels 230b-230e, 240b-240e, respectively.

Jig 200 preferably includes two further features that assist in the forming of holes 112 in locks 100 of the present invention. Firstly, referring to Fig. 7, showing the back view of jig 200, an end stopper 260 may be positioned abutting the back surface 212 of body 210. End stopper 260 as shown in Fig. 7 may comprise a rigid
steel, brass or aluminum slab, which is fixedly joined to body 210 via a screw or bolt 262 that is drilled into body 210. Alternatively, stopper 260 may comprise any alternative component for preventing the end of housing inserted to cavity 220 from protruding from cavity 220 past the back surface 212, and may be joined to body 210 by an appropriate means such as by glueing, bolting riveting, welding, etc. Alternatively, cavity 220 is closed at its back end, such that the end stopper 260 is essentially the back wall of cavity 220.

A second feature of jig 200 is a means to hold a lock housing within cavity 220. Fig. 8 is an isometric projection of jig 200. Two holes 270a, 270b bored through the side wall 214 are shown. The holes 270a, 270b may be spaced longitudinally from each other, preferably parallel to the longitudinal axis of jig 200. Internal threads 272 are shown in the empty first hole 270a, and a screw 274 is shown threaded in second hole 270b. When a lock housing (10 - Fig. 1, 100 - Fig. 2) is disposed in cavity 220, screw 274 is rotated such that its tip presses and holds the lock housing 10, 100 in a fixed position for drilling holes into the lock housing, as described herein below. A similar screw to screw 274 is preferably inserted into hole 270a when in use for further maintaining the lock housing within cavity 220 fixed, rigidly in position within jig 200. According to an alternative embodiment, only one hole and screw are present in jig 200. Alternatively, no screws are present, and the lock housing is held in place either manually or by another tool such as a vise, etc.

Thus with reference to Fig. 9, a transverse cross-section through chamber 30a of a lock housing 10 positioned in the cross-sectional view of jig 200 is shown. In order to form bore holes in a conventional prior art lock housing 10, the housing 10 is first positioned within cavity 220 of jig 200 and positioned such that the end of housing 10 inserted in cavity 220 abuts the end stopper 260, such that chambers 30a-30e are aligned with respective channels 250a-250e of tool.

In a preferred embodiment, screw 274 is rotated as described above in order to hold housing 10 rigidly in a fixed position within cavity 220.

It will be appreciated that Fig. 9 is schematic and the space shown in cavity 220 between lock housing 10 and body 210 is exaggerated for illustrative purposes,
and typically there is a much closer clearance fit. Typically, at least a portion of housing 10 is positioned flush against at least a portion of body 210.

In general, when drilling on a surface at an angle, it is preferable to first form a priming notch in the surface at the point where the drilling is desired, in order to prevent slippage of the drill bit along the surface at first contact. Such a notch serves to catch and guide the drill bit to the desired drilling point. For this purpose, referring to Fig. 10, a notch 114a is preferably formed in lock housing 10 by drilling through channel 230a, as indicated by arrow 202, for assisting in the drilling of a hole in housing 10, the drilling being performed via the through channel 240a which serves as a drill guide as described herein below.

Referring to Fig. 11, a hole 13a is drilled in housing 10 via channel 240a, as indicated by arrow 204, thereby forming the first hole 13a of the modified lock housing 100 in accordance with the present invention. It is understood that additional holes are drilled through the corresponding channels of jig 200 in the same manner.

In consequence of the modification, once the pin stopper is removed from its chamber, access to the chamber may be achieved via the outer opening of the chamber. Repair may be performed, by, for example, removing the components of the pin stack contained in the chamber, either through the outer opening, or by pushing the components out of the inner opening and removing them via the cylindrical bore.

As mentioned above, the third series of channels 250 is optional. It is preferably present in jig 200. This is because in order to drill the holes within the lock housing, strictly speaking, channels 250 are not required. The channels 250 merely assist in the alignment of the housing within the tool cavity 120, but such alignment may be performed without the use of channels 250.

In the preferred embodiment, wherein such channels 250 are present, the channels 250 may be used for replacing the pin stoppers 142a-142e in their respective chambers 130a-130e within the housing 100. Channels 250 are preferably threaded, such that a screw (not shown, but typically similar to screw 274) may be inserted therein. A pin stopper 142 is positioned on the outer end of a chamber 130a-130e, and the screw is rotated in the corresponding channel 250a-
25Oe, thereby forcibly pushing the pin stopper 142a-142e into position within its chamber 130a-130e in the lock housing 100.

As seen in Figs. 5-11, in preferred embodiments the lower end of jig 200 narrows a triangular tip 275. This geometrical configuration is preferred as it enables jig 200 to be fixedly held by a holding tool, such as a vise, clamp or chuck during the drilling process, however, alternative configurations may be utilized for appropriate holding means.

Referring to Figs. 12a and 12b, in order to remove a pin stopper 142a (shown enlarged for illustrative purposes) from its chamber 130a (see Fig. 3) using the present invention 100, a hole 50 must be first drilled in the pin stopper 142a while disposed in chamber 130a. Hole 50 is drilled longitudinally at the outer end 141a of the pin stopper 142a which is essentially planar with the outer end 134a (see Fig. 3) of chamber 130a, open to the outside of housing 130. A hole 50 is drilled at least part of the way through the pin stopper 142a. Preferably, hole 50 is drilled half way through pin stopper 142a, though in some embodiments, the hole 50 may be less than or greater than half way through pin stopper 142a, and in some embodiments, the hole 50 may extend entirely through the pin stopper 142a. The hole 50 is threaded internally, to receive the threaded tip 316 of shaft 310 of device 300, as described herein below.

It is understood that the pin stopper 142a) and hole 50 are shown as examples for illustrative purposes, and that a similar hole is required to be bored into each of the additional pin stoppers 142b-142e of lock housing 110.

A preferred embodiment of a pin remover device 300 of the present invention, generally designated by numeral 300, is shown in an assembled front view in Fig. 13a, in an assembled side view in Fig. 13b, in an assembled top view in Fig. 13c and in an exploded front view in Fig. 14. With reference to Figs. 13a, 13b, 13c and 14 as appropriate, pin remover 300 comprises an elongated shaft 310 (see Fig. 14) comprising a handle portion 312 a central portion 314 and a threaded tip 316 (insertion component). The central portion 314 of shaft 310 is disposed within hollow screw 320, and is freely rotatable about its axis. Hollow screw 320 comprises a head portion 322 for gripping and rotating, and a body portion 324 having an outer surface which is externally threaded. The head portion 322 of the present invention preferably comprises opposing truncated sides (shown in Fig. 13c) for
aiding the user to grip same. The gripping surfaces may be patterned for easy gripping, however no truncated sides may be present in some embodiments. In alternative embodiments, the periphery of head portion 322 may comprise a hexagonal nut shape. An internally threaded lock saddle 330 is positioned along body portion 324 of hollow screw 320. A nut 340, having an outer diameter larger than the diameter of the opening 326 at the distal end 321 of hollow screw 320 is positioned around threaded tip 316, to prevent shaft 310 handle 312 from sliding through distal end 321 of hollow screw 320. The diameter of the handle portion 312 is larger than the opening 323 at the proximal end 325 of hollow screw 320, to prevent shaft 310 from sliding through the proximal end 325 of the hollow screw 320.

As mentioned herein above, the present invention enables the unblocking of a pin stack jam in one of the chambers 130 of a lock housing 100. This is performed by utilizing the tool 300 of the present invention to remove the pin stopper 142 from the outer end of its chamber 130.

In order to remove a pin stopper 142a using the device of the present invention, the following steps are taken, as described herein below, and depicted in Figs. 15a—15c, showing a cross-section of housing 100 taken along chamber 130a in Fig. 3, having pin stopper 142a positioned at the upper end thereof.

Firstly, in a preliminary step, a threaded hole 50 is provided in pin stopper 142a, as described herein above. Then, with reference to Fig. 15a, the threaded distal tip 316 of the tool 300 is screwingly inserted into the threaded hole 50. The housing 100 is maintained in a fixed position, and the handle portion 312 is rotated (clockwise if provided with regular right-handed screw thread, in the preferred embodiment) until the tip 316 is tightly screwed in hole 50, which is typically until the tip 316 is entirely inserted into the hole 50 and/or until the free end of the tip 316 contacts the bottom of the hole 50. Then, with reference to Fig. 15b, the lock saddle 330 is oriented to enable its curvature to saddle the housing 130. The housing 130 is fixedly held, either in the hand, or in a tool, such as the jig 200 herein above, and lock saddle 330 is maintained in its saddling orientation perhaps, using one's left hand, while head portion 322 is rotated (right-handedly, in the preferred embodiment. Lock saddle 330 is threaded with a left-hand tap to produce a reverse thread on the body portion 324. Thus, when head portion 322 is rotated in
a first direction (e.g. right handed), lock saddle 330 shifts along body portion 324 towards the distal tip 316, as indicated by arrow 302 in Fig. 15b. The head portion 322 is rotated until lock saddle 330 contacts the housing 10 and "saddles" the housing 100 around the chamber 130a, as shown in Fig. 15b. Finally, with reference to Fig. 15c, the lock saddle 330 and housing 130 are fixedly held together, while head portion 322 is continued to be rotated (right-handed, in the preferred embodiment). Since lock saddle 330 and housing 130 are fixedly held in place, the rotation of head portion 322 in a first direction (e.g. right handed) causes body portion 324 to shift through lock saddle 330 as indicated by arrow 304 in Fig. 15c. This creates a torque force, which enables pin stopper 142a to be pulled out of chamber 130a while being threaded on the distal pin 316, through the upper end of chamber 130a.

Once the pin stopper 142a is removed from its chamber 130a, access to the chamber 130 may be achieved via the outer opening of the chamber 130. Repair may be performed, by, for instance, removing the components 142, 144, 146 of the pin stack 140 contained in the chamber 130 either through the outer opening 134, or by pushing the components 142, 144, 146 out of the inner opening 132 and removing them via the cylindrical bore 120.

It is understood that the above description of the embodiments of the present invention are for illustrative purposes only, and is not meant to be exhaustive or to limit the invention to the precise form or forms disclosed, as many modifications and variations are possible. Such modifications and variations are intended to be included within the scope of the present invention as defined by the accompanying claims.
CLAIMS:

1. A set comprising:
   (i) a tumbler lock housing;
   (ii) a jig, and
   (iii) a pin stopper extractor tool,
wherein the tumbler lock housing includes a cylinder rod for receiving a cylinder and a block comprising at least one chamber; each chamber extending substantially perpendicularly to the cylinder rod and serving to receive a pin stopper; the pin tumbler lock housing further comprising a secondary access hole bored into each chamber from a side of the block, each secondary access hole to provide access to a jammed pin stopper in the chamber, to facilitate unjamming of the pin stopper;

2. A pin tumbler lock housing comprising a cylindrical bore and a block, the cylindrical bore adapted to receive a lock plug cylinder, and further
comprising a series of chambers located in said housing running parallel to axis of said cylindrical bore, wherein each chamber in said series extends radially from said cylindrical bore through said block, and each of said chambers is adapted to receive a pin stack, and an inner end of each chamber opens to said cylindrical bore and an outer end of each chamber opens to the outside of said housing, wherein at least one secondary access hole is provided through the housing and into at least one chamber from a side of the block, each secondary access hole to provide access to a jammed pin stopper in the chamber, to facilitate unjamming of the pin stopper.

3. The pin tumbler lock housing of claim 2 wherein each said secondary access hole enters said chamber at an angle.
4. The pin tumbler lock housing of claim 2, wherein each chamber is provided with a secondary access hole for aiding unjamming of a tumbler in said chamber.

5. The pin tumbler lock housing of claim 2, wherein two secondary access holes enter said chamber.

6. A pin tumbler lock according to claim 2, wherein each secondary access hole is angled at an angle of more than 90 degrees to the chamber.

7. A jig for forming a series of holes in the housing of claim 2, wherein said jig has a body comprising a cavity for receiving said housing therein, and further comprising a first series of guide channels running longitudinally along said body, wherein each guide channel in said first series is bored through said body.

8. The jig of claim 5, wherein a second series of channels is provided along a side of said body, and wherein said channels couple outside of said jig with said receiving cavity.

9. The jig of claim 5 wherein the first series of channels guides a boring tool to bore a series of access holes in a lock housing within the cavity such that each of said first series of access holes provide access to chambers in said lock housing.

10. The jig of claim 7 wherein a second series of channels is provided for guiding a tool to bore a second series of access holes in said housing.

11. A jig of claim 5 comprising a front end for receiving a lock housing, and an end stopper for preventing said housing from extending past a back end of said jig.

12. The jig of claim 11, wherein the end stopper comprises a slab fixedly abutting the back end of said tool.

13. The jig of claim 5, further comprising a holding means for fixedly maintaining the housing within the receiving cavity.
14. The jig of claim 13 wherein said holding means comprises at least one threaded through hole and a corresponding screw for screwingly inserting into said through hole such that a tip of said screw presses said housing against an inside wall of the receiving cavity of said jig.

15. A method of forming a series of holes in the lock housing of claim 1, comprising the steps of:
   a. inserting said housing into the tumbler-lock-housing receiving cavity of the jig;
   b. aligning said housing within said cavity, and
c. drilling holes through first series of access channels into said chambers.

16. A method according to claim 15, wherein said aligning step b is performed by positioning an end of the housing against back end of the jig.

17. A pin stopper extractor tool for extracting a pin stopper from an outer end of a chamber of a cylinder lock housing, wherein said pin stopper comprises a tapped hole in an outer end of said pin stopper facing towards outside of said housing and said pin stopper extractor tool comprises a threaded tip for screwably inserting into said tapped hole, and for removing said pin stopper from said chamber.

18. The pin extractor tool of claim 17 for removing a pin stopper from the outer end of a chamber in a lock housing, wherein said extractor tool comprises
   a. an elongated shaft comprised of:
      i. a proximal handle portion;
      ii. a central portion; and,
      iii. a threaded distal tip;
   b. a hollow screw in which said central portion is disposed, said hollow screw comprising:
      i. a head portion for gripping and rotating; and,
      ii. a body portion having an external threading;
c. a lock saddle having internal threading for positioning along said body portion of said hollow screw; and,
d. a nut positioned around said distal tip, for preventing said shaft from sliding through said hollow screw, wherein said threaded distal tip for inserting into the hole in the pin stopper.

19. An extractor tool according to claim 17, wherein external diameter of the handle portion is larger than the internal diameter of the hollow screw, to prevent the shaft from sliding through said hollow screw.

20. An extractor tool according to claim 17, wherein the proximal handle portion, the central portion and the threaded distal tip of the elongated shaft are manufactured as a single integral component.

21. A device according to claim 17, wherein the central portion of the shaft is freely rotatable within the hollow screw.

22. A device according to claim 17, wherein the body portion of the hollow screw has left handed external threading.
SECTION A-A

134E 134D 134C 134B 134A
142E 142D 142C 142B 142A
140
144
146

130E 130D 130C 130B 130A
120
121
132E 132D 132C 132B 132A

110

Fig. 3

SECTION B-B

134A
142A
112A
130A

120
132A
110

Fig. 4