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The Examination of Disc and Pin Tumbler Locks for Tool Marks Made by Lock Picks

There are many references on the techniques of lock picking (for example, Refs *1* and *2*) and on the subject of tool mark examination (Ref *3*, for example), yet there are only a few articles published on the tool marks made by lock picks [*4–6*]. These articles indicate that certain methods of picking locks can be detected. No in-depth study has been published on the types of marks left by different picks, nor to what extent tumbler composition plays in detecting pick marks. It is the purpose of this study to indicate what can be learned from pick marks on cylinder locks. This paper will attempt, through use of photographs, to demonstrate the tool marks often left on pin and disc tumbler locks by various lock picks in use today.

Introduction

In an attempt to pick a lock cylinder, the internal components (tumblers) are manipulated to simulate the action of the correct key and then the plug, which contains the keyway, is rotated to activate the bolt. An instrument called a "lock pick" is used to manipulate the tumblers while a "tension wrench" is used to rotate the plug. Lock picks and tension wrenches are usually made of spring steel, while tumblers and plugs are usually made of brass or nickel silver. Because these picks are thin, have sharp edges, and are harder than brass or nickel silver, the internal parts of the cylinder that come into contact with them are marked. Tool marks produced by tension wrenches are usually located only on the plug, while tool marks produced by lock picks (pick marks) may be found on the plug and on the tumblers. It is these pick marks with which this investigation will be concerned.

Procedure

The wear and pick marks on 300 pin tumblers, 225 disc tumblers, 20 pin tumbler plugs, and 15 disc tumbler plugs were examined under a variable power (×8 to ×30) dissecting scope. The manufacturer of the cylinder, type of tumbler, tumbler manufacturer, and composition of the tumblers are listed in Table 1. The style and manufacturer of the lock picks used are listed in Table 2. Several of each type of cylinder, with the listed tumbler, were picked by each listed pick. The wear characteristics of the plugs and tumblers were obtained by operating the cylinder with a factory-cut key. Photographs were taken of each set of tumblers. The plug was cut into two pieces and the interior examined and photographed.

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TABLE 1—*Lock cylinders[a] and tumblers used in this investigation.*

Manufacturer of Cylinder	Type of Tumbler	Manufacturer of Tumbler	Composition of Tumbler
Ilco	pin	Zipco	brass
Ilco	disc	Ilco	brass
Kwikset	pin	Kwikset	nickel-plated brass
Schlage	pin	Schlage	nickel silver[b]
Schlage	disc[c]	Schlage	steel
Yale	pin	Yale	brass
Yale	disc	Yale	brass

[a] Cylinders were of the type employing a paracentric key.
[b] Nickel silver is an alloy of copper, nickel, and zinc.
[c] Schlage wafer is a type of disc tumbler.

TABLE 2—*Types of picks used in this investigation (picks were made from spring steel).*

Pick Type	Manufacturer
hook	homemade
rake	H.P.C. Inc.
bounce pick (Lockaid Tool)	Hesse-Majestic
bounce pick (snapper)	homemade

A brief study was conducted to determine what effects picks composed of materials softer than spring steel would have on the tumblers. The cylinders in this group were picked using rake picks made from celluloid, a paper clip, and commercially available Teflon®-coated picks. The tool marks made by these lock picks were compared to the tool marks made by the spring steel lock picks.

Definitions and nomenclature used in this report conform to those used by the *Locksmith Ledger and Security Register* [7].

Results

Most pick marks are located on the face of the tumbler (the surface that comes into contact with the key). However, some pick marks may also be located on the side of the tumblers facing the front of the keyway. Pick marks on the plug may be found on the face and on the top or side of the keyway (Fig. 1). If the cylinder has a plug cap or tailpiece plate that covers the keyway, some pick marks may be found there. No pick marks of any significance were located on the housing of the cylinder. In each of the lock cylinders that were picked, all of the tumblers showed some evidence of pick marks.

Marks produced by a key (wear marks) on the tumblers of a cylinder (Figs. 2, 3, and 4) appear as a single large wear area on the face of each tumbler. The wear marks are more pronounced on the pins near the front of the lock cylinder and become less pronounced toward the rear. There are no obvious striated or impression marks on the tumblers of cylinders that have only been operated by the proper key. Tumblers from a cylinder that have been manipulated with a hook or rake pick (Figs. 5, 6, 7, and 8) have striated marks on each tumbler. Tumblers from a cylinder that have been manipulated with a bounce pick (Figs. 9, 10, and 11) have impression marks. The bounce picks

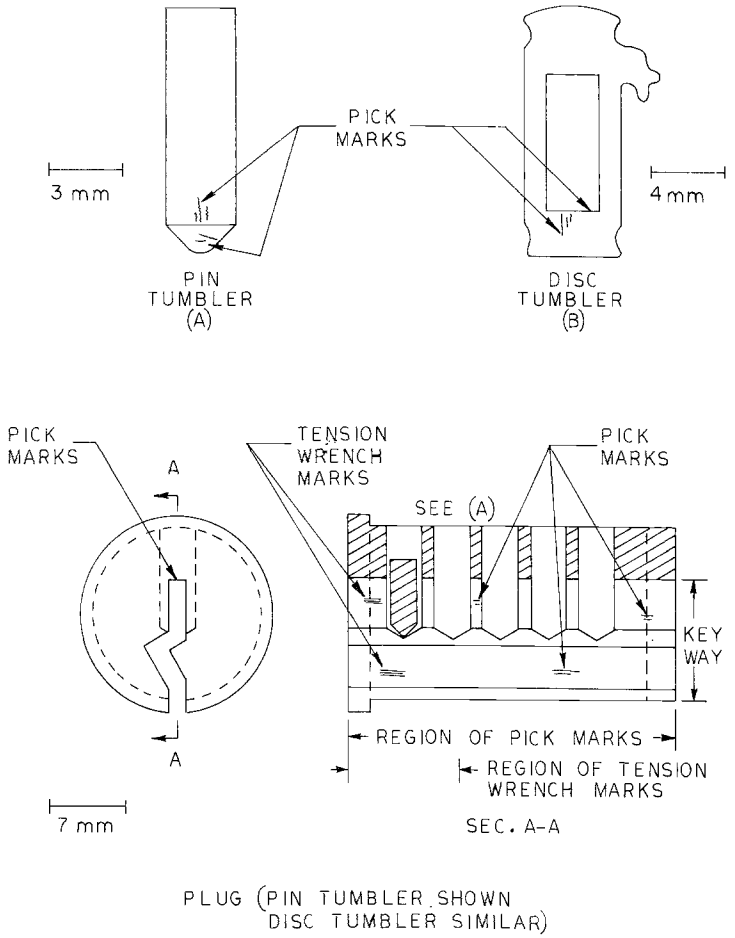

FIG. 1—*Location of pick and tension wrench marks.*

produce some striated marks, but a large percentage of the pick marks on the tumblers are impression marks. The general appearance and the detectability of both the striated and impression marks did not vary among the brass, nickel-plated brass, or nickel silver tumblers. On steel tumblers the pick marks were very light and difficult to observe. Even knowing which cylinders had been picked, it required careful observation to distinguish the pick marks from manufacturing tool marks. On an unknown cylinder, employing steel tumblers, it is entirely possible that pick marks might not even be recognized as such. Pick marks on all tumblers were durable and were not erased by several subsequent operations of the cylinder with the proper key.

Pick marks found on the inside surfaces of the keyway and on plug caps or cam retainers are the same type as those found on the tumblers. To observe the marks in the keyway, the plug must be milled or cut to allow the plug to be opened, but not so extensively as to destroy the keyway. If the examination of the tumblers is not conclusive, as might be the case with steel tumblers, an examination of the plug is recommended. If the cylinder had been operated many times since the picking took place, the top and some portion of the sides of the keyway could provide some information because these areas do not come in contact with the key.

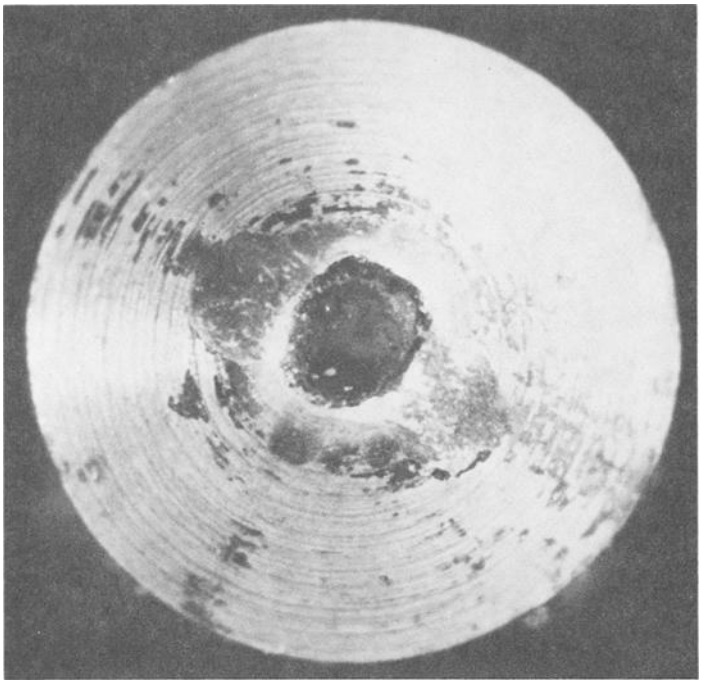

FIG. 2—*Schlage pin tumbler from a lock cylinder that had been operated 5000 times with the key. Pin diameter is 2.91 mm (0.115 in.).*

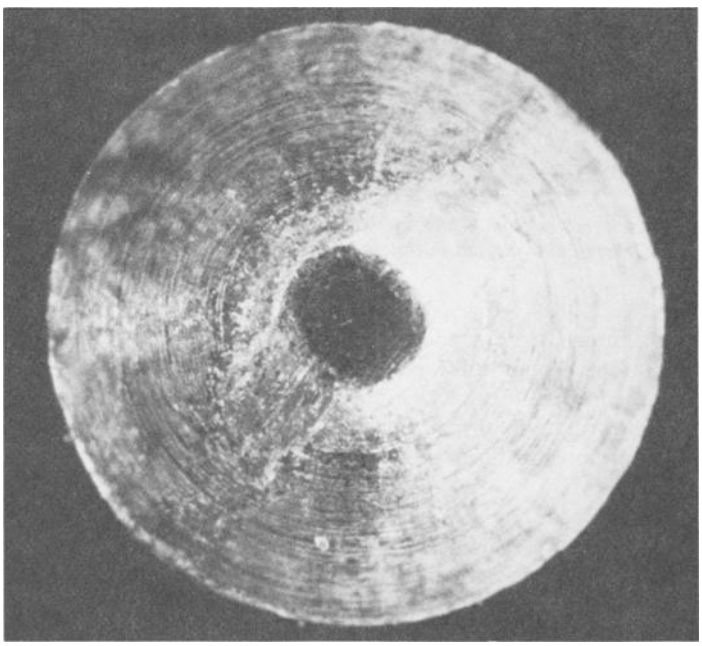

FIG. 3—*Zipco pin tumbler from a lock cylinder that had been operated 5000 times with the key. Pin diameter is 2.92 mm (0.115 in.).*

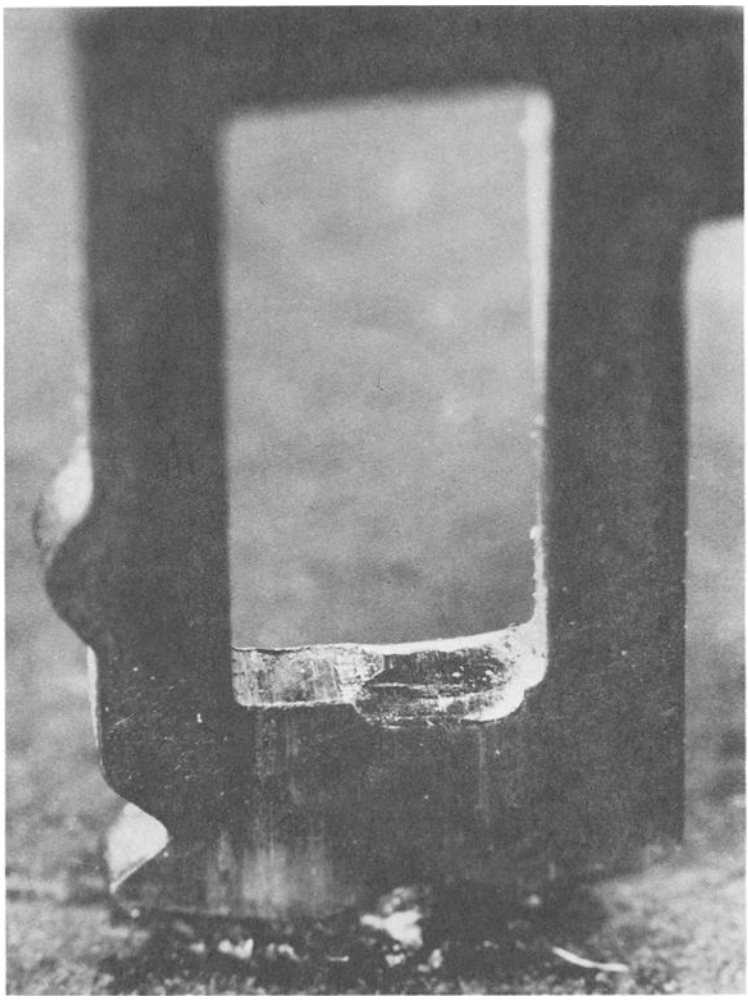

FIG. 4—*Ilco disc tumbler from a lock cylinder that had been operated 5000 times with the key. Disc width is 4.85 mm (0.191 in.) and thickness is 0.73 mm (0.028 in.).*

Some manufacturers (Corbin and Russwin) use ball bearings in their pin tumbler cylinders in the first two or three pin wells to reduce wear on the pins. These ball bearings are marked by the lock picks in the same manner as the pins. Because these ball bearings are free to rotate in any direction, they usually acquire marks over their entire surface. This contributes to the identification because of the greater number of marks (Figs. 12 and 13).

The pick marks made by the celluloid, paper clip, and commercially available Teflon®-covered picks were almost indistinguishable from those marks made by the spring steel rake picks. It was not expected that the celluloid picks would mark the pins to the extent they did. As expected, the paper clip pick, being metal, left pick marks. The Teflon® on the Teflon®-coated pick wore off very easily, leaving the spring steel base metal exposed. As a result, pick marks were prevalent.

It was discovered that the bounce picks were very successful at picking the disc

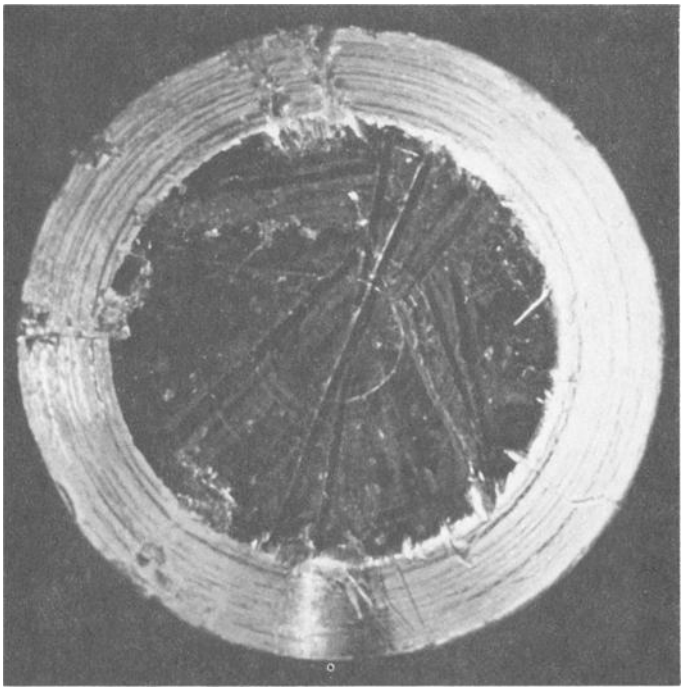

FIG. 5—*Kwikset pin tumbler from a lock cylinder that had been picked with a hook pick. Pin diameter is 2.92 mm (0.115 in.).*

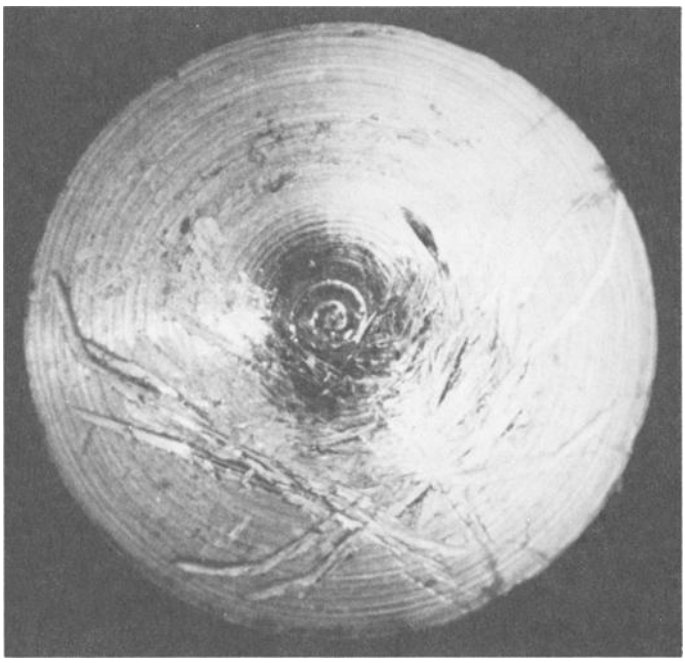

FIG. 6—*Yale pin tumbler from a lock cylinder that had been picked with a hook pick. Pin diameter is 2.92 mm (0.115 in.).*

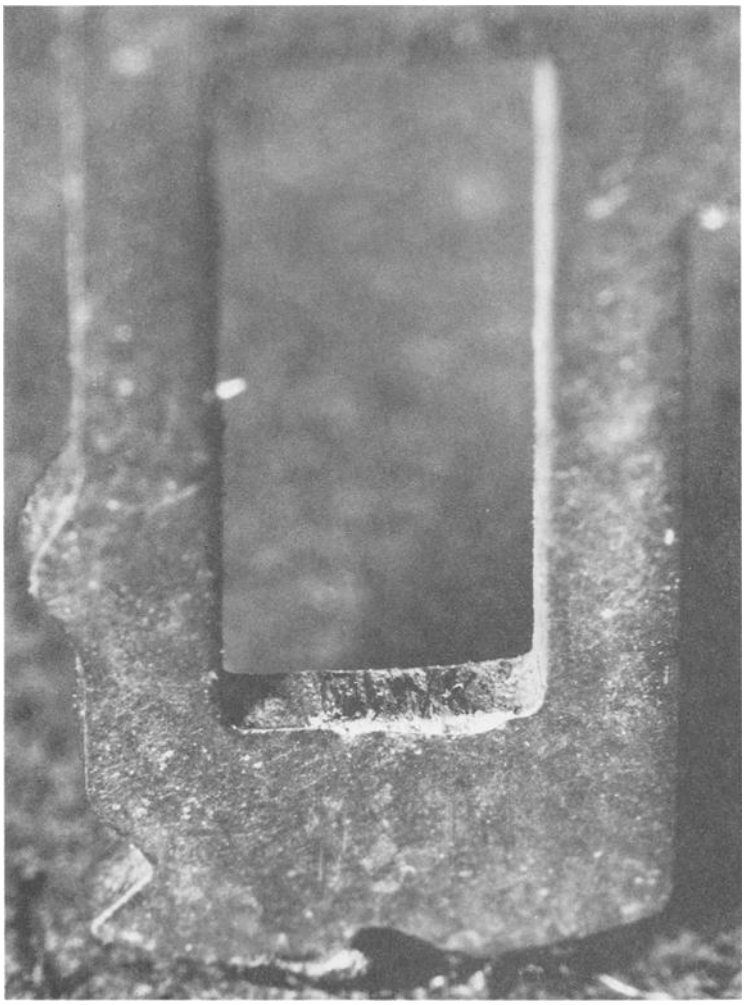

FIG. 7—*Ilco disc tumbler from a lock cylinder that had been picked with a rake pick. Tumbler width is 4.85 mm (0.191 in.) and thickness is 0.73 mm (0.028 in.).*

tumbler lock cylinder. This was surprising, since the bounce pick is specifically designed to pick the pin tumbler lock.

Conclusion

If a lock is suspected of having been picked, an examination could reveal if an instrument other than a key had been inserted into the cylinder plug of the lock. The examiner could state an opinion as to whether an attempt had been made to pick the lock, whether or not the attempt might have been successful, and the general type of pick used. If a tool is located that is suspected of being used in an attempt to pick a given lock, the examiner may be able to state an opinion as to whether or not the suspect tool could have been used in the given lock. With this information, evidence from the scene, and the facts of the case, the investigator should be able to determine whether the lock had been neutralized with picks, operated by a key, or simply left unlocked.

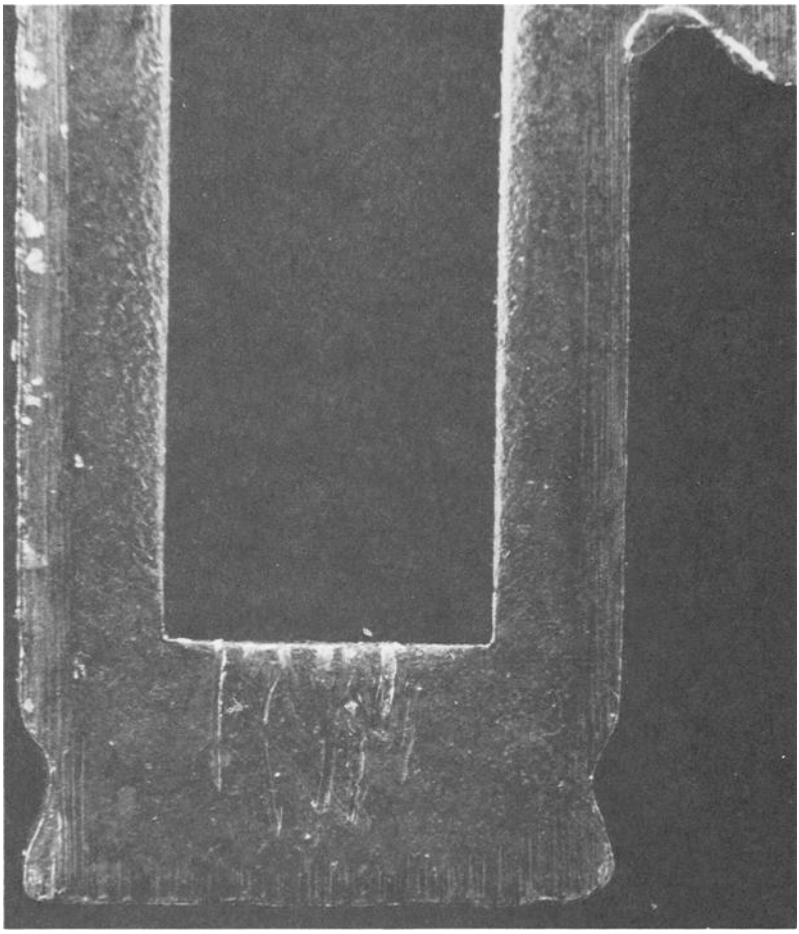

FIG. 8—*Yale disc tumbler from a lock cylinder that had been picked with a rake pick. Tumbler width is 4.85 mm (0.191 in.) and thickness is 0.73 mm (0.028 in.).*

Summary

Microscopic examination of the tumblers of pin and disc tumbler lock cylinders may indicate whether an attempt has been made to pick the lock. If an attempt has been made to pick the lock, it is often possible to determine what type of pick was used. Lock cylinders of five manufacturers, employing tumblers of several different compositions, were examined. The lock cylinders were picked with rake, hook, and bounce picks made of spring steel. The cylinders were disassembled and examined for pick marks. The location and appearance of the marks are discussed. Briefly mentioned are the effects of other types of picks and the effect of ball bearings in the pin wells. Photographs are included to show the pick and wear marks.

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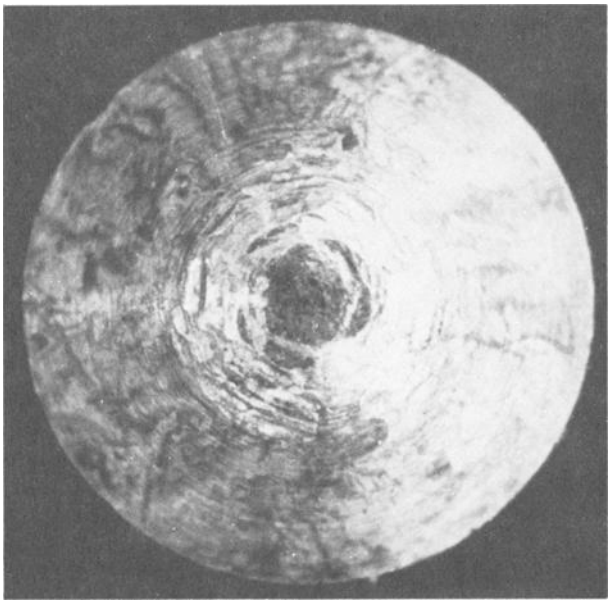

FIG. 9—*Zipco pin tumbler from a lock cylinder that had been picked with a bounce pick. Pin diameter is 2.92 mm (0.115 in.).*

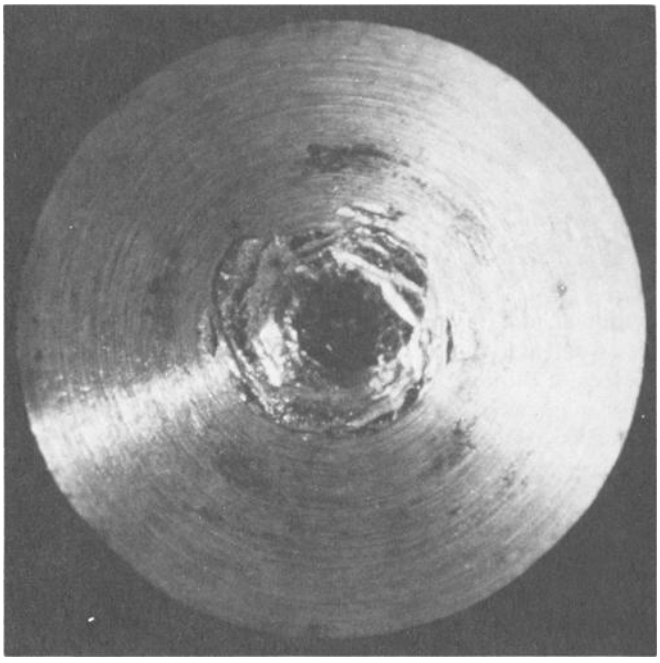

FIG. 10—*Schlage pin tumbler from a lock cylinder that had picked with a bounce pick. Pin diameter is 2.91 mm (0.115 in.).*

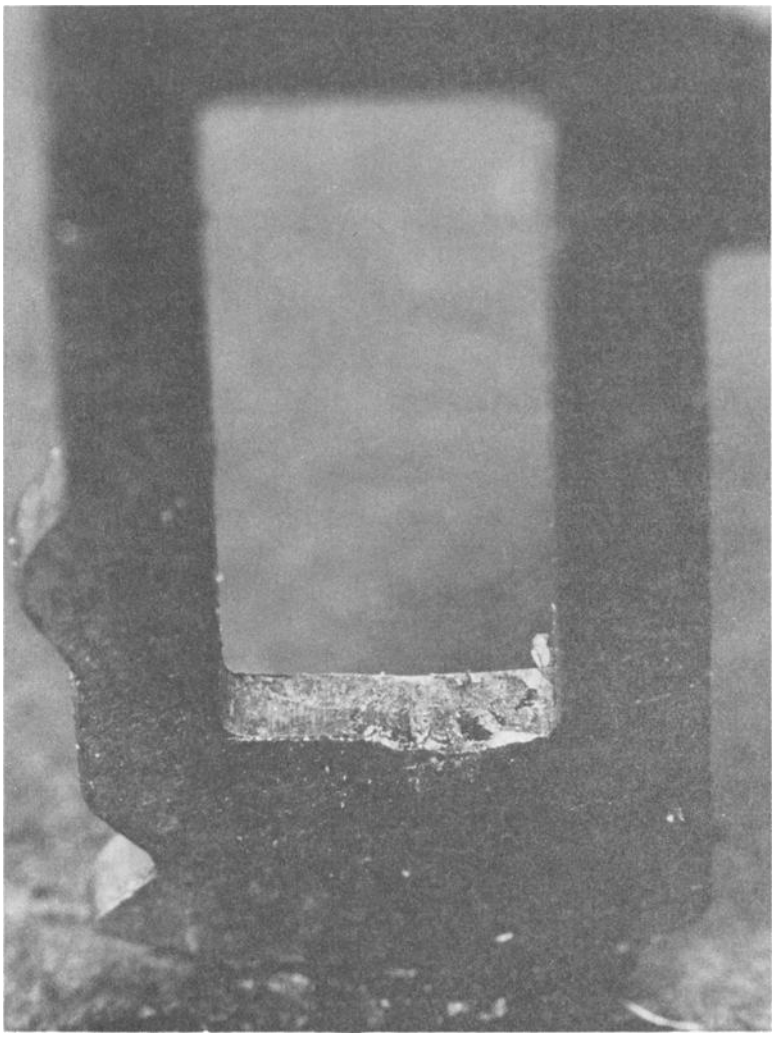

FIG. 11—*Ilco disc tumbler from a lock cylinder that had been picked with a bounce pick. Disc width is 4.85 mm (0.191 in.) and thickness is 0.73 mm (0.028 in.).*

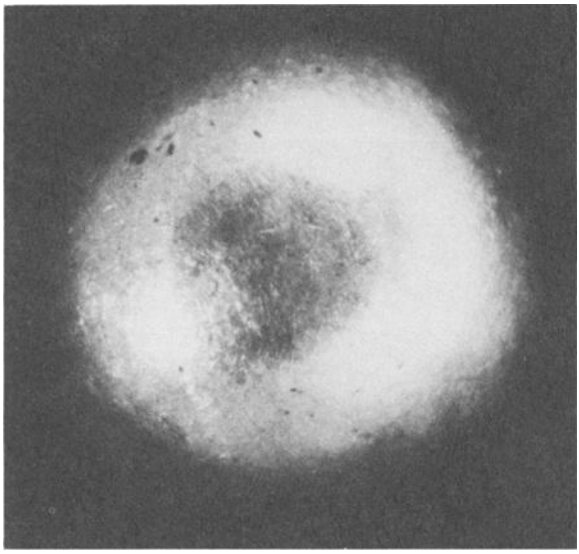

FIG. 12—*Corbin ball bearing from a lock cylinder that had been operated with the key. Ball diameter is 2.79 mm (0.110 in.).*

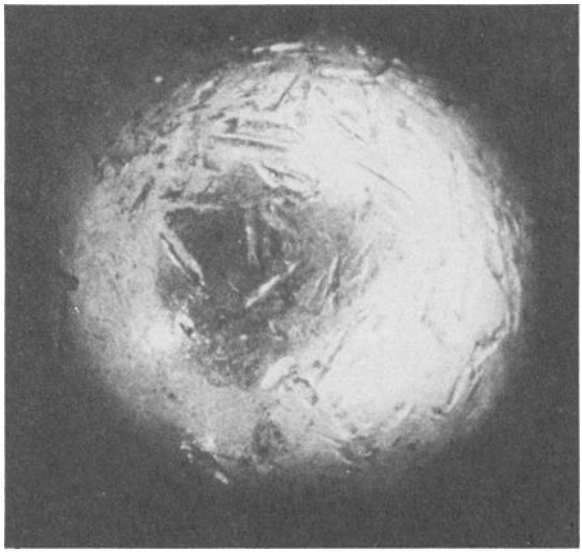

FIG. 13—*Corbin ball bearing from a lock cylinder that had been picked using a bounce pick. Ball diameter is 2.79 mm (0.110 in.).*

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