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How To Make KEYS By The IMPRESSION METHOD

THE MARK OF THE MASTER LOCKSMITH

How to Make Keys

by the

IMPRESSION SYSTEM

The theory behind the process of fitting keys to locks without removing or disassembling them, as practiced by Master Locksmiths throughout the World

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Key Fitting by Impression

Fitting a key directly to a lock without removing it from the door is one of the highest skills in Locksmithing. The advantage is that this system makes it unnecessary to pick open or disassemble the lock. Experienced persons frequently can fit keys more rapidly by impression than by any other known method.

The impression system of key making is based on the fact that the mechanism of a lock will leave a mark or impression on the key blank. This discussion concerns the manner in which these marks are made, and how to file the key blank until it becomes the correct key to fit the lock.

WARDED BIT KEY LOCKS

A ward in a lock is an obstruction that prevents a blank or key from turning or reaching the mechanism that operates the lock. This construction is found in all inexpensive locks whether it be house locks, padlocks, or cabinet locks. The wards are the only security that these types of locks afford (Fig. 1).

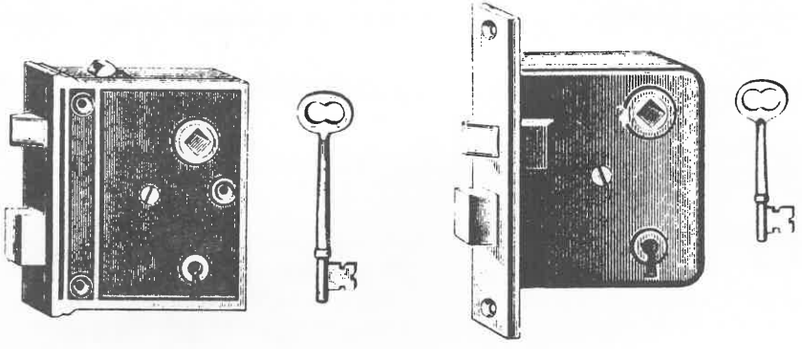

Fig. 1—Rim and Mortise Warded Bit Key Locks

In an inexpensive bit key lock, the wards are usually placed so that the key cannot turn unless the bit is filed where the wards prevent the turning of the key (Fig. 2). Manufacturers are able to prevent one key from working all of these types of locks by varying the position of the wards. An additional means of security is used also to prevent the key blank from being inserted into the keyway of the lock. This consists of adding small projections or wards to the keyholes, so that the keys have to be grooved or filed along the side of the bit in order to enter the lock (Fig. 3)

When fitting a key to this type of lock, the first consideration is

the pin. The correct diameter may be determined by inserting a twist drill or gage into the key hole. Since several standard sizes are com-

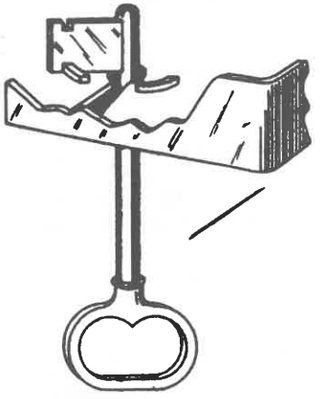

Fig. 2—Key Can Turn Because Cuts in Bit Clear the Wards

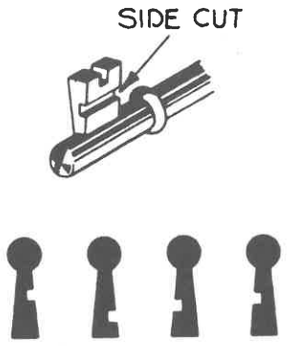

Fig. 3—Bit Filed to Enter Warded Keyway Sketches Show How Wards May Be Positioned

monly found, most locksmiths have a set of gages that they manufacture themselves by filing off the bits of a few different size key blanks (Fig. 4).

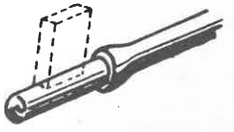

Fig. 4—Pin Gage Made From Bit Key

The next step is to file the bit to the proper height so that the blank can enter the lock. This measurement can be taken by measuring the keyhole with a pair of inside calipers or dividers (Fig. 5). Most locksmiths prefer to do the job by merely filing and trying the blank in the keyhole until it enters the lock.

When a keyway ward is encountered, however, the blank will not enter the lock until the side groove has been made. If calipers are not available, this ward can be located by smoking the key with a match flame and inserting the pin into the key hole. In the illustration (Fig. 6), it will be noticed that the blank is inserted at a slight angle, so that

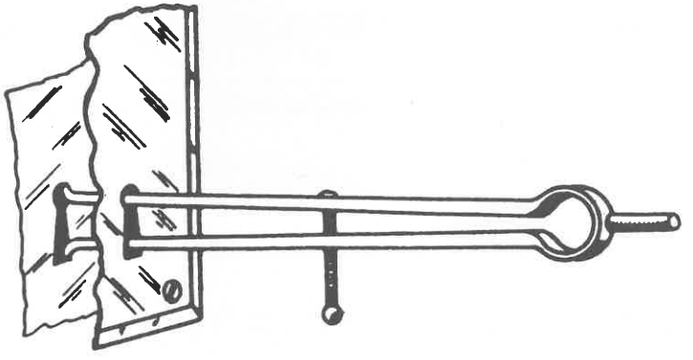

Fig. 5—Taking Measurement of Keyhole for Height of Bit

when the blank is pivoted downward, the first obstruction or ward will mark the smoked portion of the bit. The groove is made at this mark.

Once the key blank can be inserted freely, the sides of the bit have to be trimmed in order to allow the blank to turn within the lock. The metal to be removed can be found by examining the forward and rear edges of the bit for impact marks.

The next problem is to obtain the location of the side wards. By smoking the bit, inserting the blank, and turning, the marks of the wards appear when the blank is withdrawn and examined (Fig. 7). When the metal at these marks has been filed away, the key will turn and engage the locking mechanism.

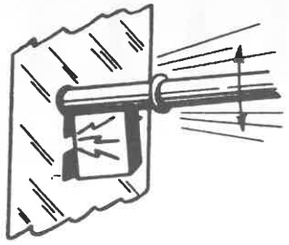

Fig. 6—Pivoting Blank to Obtain Groove Mark

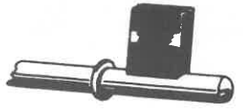

Fig. 7—Impact or Impression Marks on Bit

Occasionally, a spring slide or lever in the locking mechanism presents another obstruction that prevents the turning of the key. This will be indicated by a mark on the face of the bit similar to the ward mark. File at this mark carefully, until the key operates the lock.

WARDED CABINET LOCKS

A warded cabinet lock (Fig. 8), using a barrel key is usually easier to fit than a bit key house lock. When working on this type of locks, it is necessary to gage the size of the pin before selecting the blank. The same types of gages as those used for bit keys can be made by filing off the bits of several barrel keys of different sizes (Fig. 9).

Fig. 8—Warded Cabinet Lock

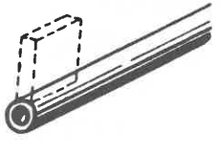

Fig. 9—Gage for Key Pin Hole

The same procedure that is used in making a warded bit key by impression is followed in making a warded barrel key. However, most cabinet locks of the warded type do not use keyway wards. All that is required, therefore, is to file the bit to the required height and

width. The location of the regular wards are obtained in the same manner as they are found in the bit key procedure (Fig 10)

Fig. 10—Relation of Bit and Ward in Cabinet Lock

Most cabinet locks of the warded type are very elementary in their construction, and as a consequence there is a tendency to be careless and file wide, jagged cuts. Since the security of these locks depends on wards alone, it is essential to make all file cuts fit the wards as close as possible. This practice will prevent the making of a key that might fit another lock.

WARDED PADLOCKS

Double-sided steel keys, usually flat or corrugated, are used in warded padlocks (Fig. 11). In fitting keys to these types of padlocks, the same method of obtaining impressions is used as on other warded locks. However, because the wards of a padlock, as shown in (Fig. 12) strike both sides of the key simultaneously, the key has to be filed on both sides In Figure 13 the depth of a ward cut is shown. Notice that it does not drop below edge of the tip. Also notice that the cut is square and clean. A key that is filed in this fashion is a strong, perfect-fitting key.

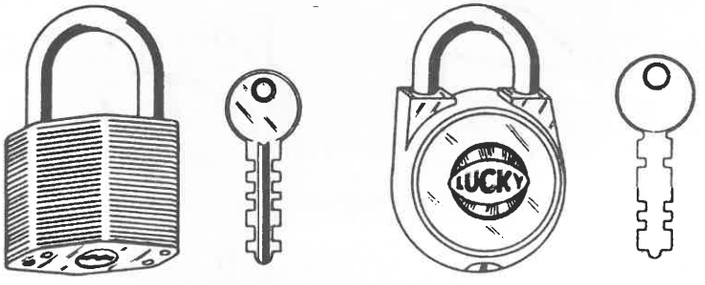

Fig. 11—Types of Warded Padlocks and Keys

Two other types of warded padlock keys that are made by the impression system are shown in Figure 14.

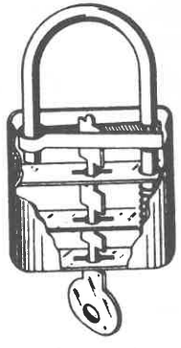

Fig. 12—Cutaway View of Typical Warded Padlock

A double-sided warded padlock key, when correctly filed, makes a half turn to open the lock. In operation, the key spreads apart the horseshoe spring, permitting the coil spring to eject the shackle (Fig. 12).

LEVER TUMBLERS

The ability to use the impression system of key fitting on lever tumbler locks (Fig. 15) is considered the mark of the master. Although the principle is universal for lever tumblers whether used in door

locks, padlocks, or chest locks. The number and types of tumblers that are found in the lock determines the difficulty of the job.

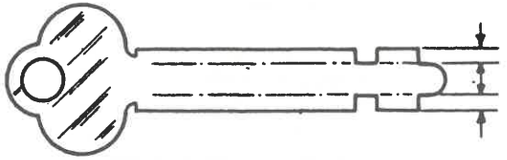

Fig. 13—Correct Shape and Depth of Ward Cuts on Padlock Key

In recalling the construction of a lever lock, it will be remembered that a fence on the bolt has to pass through a slot or gate before the

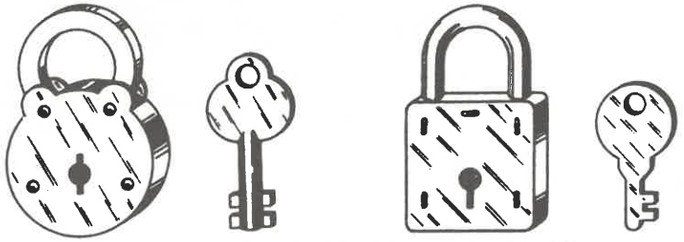

Fig. 14—Warded Padlocks Using Different Type Ward Keys

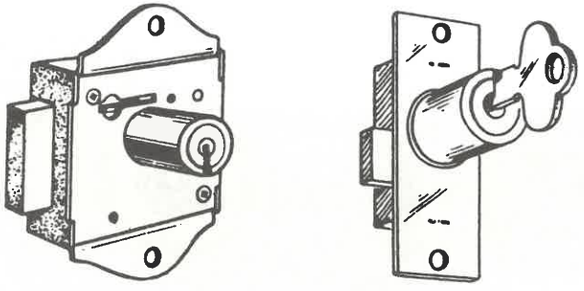

Fig. 15—Lever Tumbler Locks

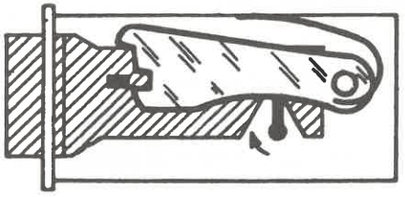

Fig. 16—Principle of the Lever Tumbler Lock

lock can be opened (Fig. 16). When the fence and the gate are out of alignment, the fence merely presses against the leading edge of the tumbler. The further the key blank is turned, the higher it pushes the tumbler. Thus, with the pressure of the fence against it, the tumbler is raised only with considerable turning pressure of the key blank. This binding appears in the form of a distinct rub on the key blank bit. This rub mark should be distinguished from the light friction mark of the tumblers caused by the action of the tumbler springs. The depth of the mark, will enable the craftsman to distinguish one from the other.

A key to a lever tumbler lock should be fitted while it is in the locked position, that is, with the bolt extended.

In the case of lever tumbler locks, it is permissible to smoke the blank with the flame of a match, candle or alcohol lamp. The blank is inserted, and all ward cuts are located by turning the key. The wards prevent the key blank from reaching the tumblers until they are by-passed by filing the ward cuts in the key (Fig. 17).

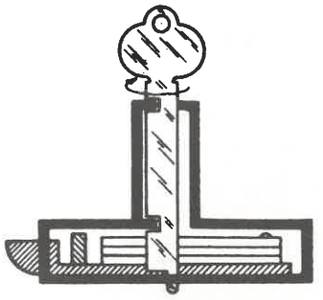

Fig. 17—Position of Wards in Lever Tumbler Cabinet Lock

After filing the ward cuts so that the blank may turn, the blank is smoked again, inserted, and sharply turned against the tumblers. Upon removal, the impressions on the blank reveal by their depth which tumbler binds most. This is the spot to file first.

By filing and re-trying the blank after every cut, the full depth finally is reached. This is recognized by the fact that the blank no longer shows impact marks. This process continues until all tumblers are brought into line with the fence, allowing the key to turn.

It should be stated that the serrated, or saw-tooth type of tumbler tends to baffle this type of fitting (Fig. 18). Since the fence locks into the serrations when the bolt is under pressure, the tumbler cannot be

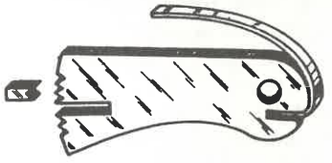

Fig. 18—Serrated Tumbler and Fence

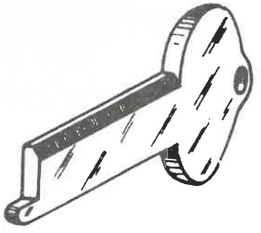

Fig. 19—Beveled Edge on Blank to Aid Observation of Impressions

moved when the blank is turned. However, when the blank is turned sharply, it will be marked by the locked tumbler just as though it were a ward instead of a tumbler.

Beginning with the first mark, file very little at a time, and try after each few strokes of the file for an impression. When the tumbler no longer shows impact marks, the slot is in alignment with the fence. Continue this process until all of the tumblers have been brought into line, and the key turns. Filing a sharp edge on the top of the blank often will aid in revealing impression (Fig. 19)

Two points should be mentioned here before leaving the subject. It is a common error to assume that the first markings are fence

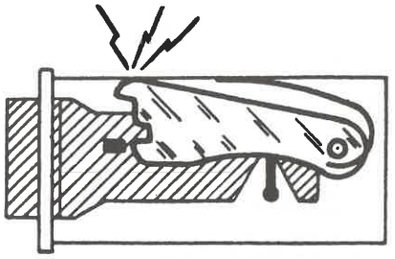

Fig. 20—Raised Lever Striking Lock Case

and tumbler impressions. Frequently, a key blank raises the lever too high causing it to stop against the rim of the lock case (Fig. 20). Nevertheless the filing should proceed carefully until enough clearance has been gained so that the blank can pull the fence to the edge of the tumblers when it turns.

In the case of mastered lever locks, the impression of the master combination may be seen first and the resulting key may be a master. It is contrary to the traditional policy of the trade to make a master key (Fig. 21) unless specifically ordered to do so by the owner of the lock. Use the master key to open the lock, then destroy it and fit a regular key in the conventional manner.

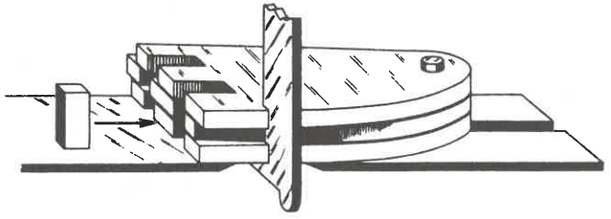

Fig. 21—Lining Up of Slots by Master Key

In fitting a double-sided flat key to a lever tumbler lock, always insert the blank so that the same edge strikes the tumblers. By keeping this rule in mind, confusion will be avoided. Frequently, in a double-sided lever tumbler lock, one lever operates in one direction, while another works in the opposite direction. Thus, while the key is being fitted, the file cuts may have to be made on opposite sides to conform to the action of the tumblers (Fig. 22).

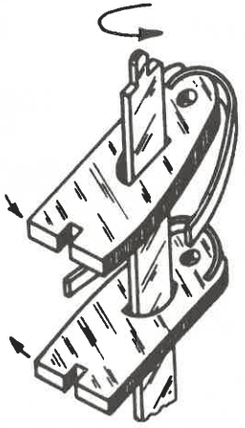

Fig. 22—File Cuts on Opposite Side of Blank to Conform to Tumbler Movement

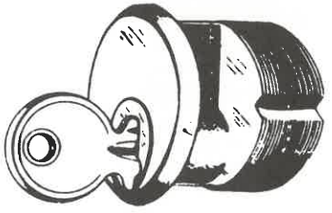

Fig. 23—Fin Tumbler Cylinder (House Lock Mortise Type)

CYLINDER LOCKS

The tremendous popularity of pin tumbler cylinder locks makes it imperative that a well qualified locksmith know how to fit keys to this type by impression. This system can be applied to most all pin tumbler cylinders, whether used on house locks, padlocks, cabinet locks, or automobiles (Fig. 23).

For the sake of simplicity, consider a lock with only one pin tumbler and driver. If a key blank were inserted in the cylinder, the pin would be pushed up into the housing. Upon any attempt to turn the blank, the pin would bind against the chamber wall as shown in the illustration (Fig. 24).

Notice that the type of driver, or upper pin does not affect this process because it is safely out of the way in the upper chamber. Since the pin is held rigidly against the wall, any movement of the blank in an up and down direction does not dislodge the pin so long as a turning pressure is maintained on the blank. All that happens as a result of the up and down movement is that a slight indentation or marking appears on the face of the key. This is the "impression" where the file cut must be made (Fig. 25).

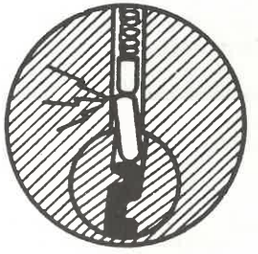

Fig. 24—Turning Pressure of Key Causes Tilting of Pin and Binding Against Chamber Wall

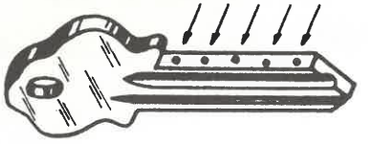

Fig. 25—Impression Marks on Cylinder Key Blank

Although the impression in a regular cylinder will be plainly visible to those with normal vision, a magnifying glass may be used as an aid in locating them. Frequently, however, the reflection of light from the bright surface of the bit hides them from view at first. But by varying the angle at which the blank is examined, the reflection can be avoided while the marks appear in clear tones.

It is not usually necessary to cover the blank with smoke in order to see impressions. As a matter of fact, many locksmiths frown on this procedure because of the harmful effects that may be produced by introducing soot into the lock mechanism. Moreover, it has been found that the smoked area usually wears off when the tumblers slide on the bit as the blank is inserted, leaving a scratched, uneven pattern that blurs the impressions. (Notice that this statement applies to pin tumbler cylinders only.)

It can be seen that a long pin will be the first to mark the key blank (Fig. 26). A long pin will also mark the key blank nearer the center of the bit as shown in the same illustration. However, the posi-

tion of the mark is usually a poor guide to follow. Occasionally a defective cylinder with out-of-line pin chambers will produce offset marks, thus falsely indicating a long or short pin. A worn chamber or pin

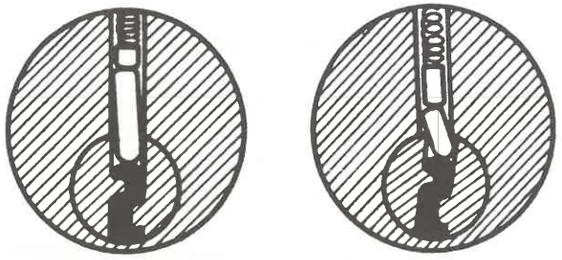

Fig. 26—Long Pin Does Not Tilt Much. Produces Mark at Center of Key Blank Bit

may do the same. It is therefore customary to use the sharpest or deepest impression for the location of the first file cut.

Every cylinder should be thoroughly cleaned before an attempt to make the key is undertaken. Dust particles, powdered metal of wearing tumblers, or foreign matter introduced by the keys themselves are frequently present in cylinders. Even graphite, which lubricates the lock, will cause the pins to slip instead of binding against the chamber walls. In order to obtain a clear, sharp impression, wash out the

.Fig. 27—Swiss File for Impression Fitting

cylinder with liberal quantities of carbon tetrachloride or unleaded (white) gasoline. A squirt can, or small syringe aids the application. Allow the fluid to dry thoroughly before attempting to fit the key.

The type of file to use for this job is an American Swiss No. 4 six-inch round file (Fig. 27). It will leave a dull finish on the cut so that impressions will stand out clearly and not be lost to sight by reflections from slick or shiny surfaces.

The blank should be soft, preferably brass, with its face carefully smoothed and dulled without removing more than a thousandth of an inch of metal. This can be accomplished by draw filing the face with two or three strokes of a file.

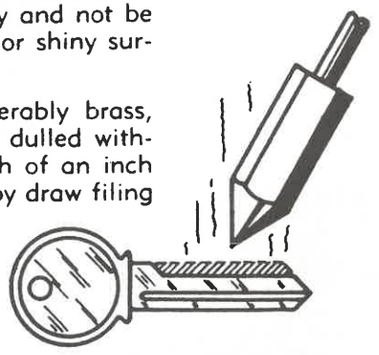

Fig. 28—Removed Portion of Bit Replaced With Solder

Some locksmiths use a specially prepared blank for impression fitting. They file off the top of a regular blank down to the first ridge, leaving a small shoulder to enter the keyway. Then they replace the metal with soft solder as shown in illustration (Fig. 28). The solder will reveal the impressions more clearly but the finished key will have to be duplicated on a

regular key blank because the soldered top will not stand up under ordinary usage. This soldered ledge is also harmful to the delicate swiss file.

The prepared blank is firmly gripped in a hand vise, inserted in the cylinder, twisted and rocked as shown in the illustration (Fig. 29). In this manner the impressions are obtained. Until experience has been gained, filing should be done very cautiously. Not more than two or three thousandths of an inch of metal should be removed at a

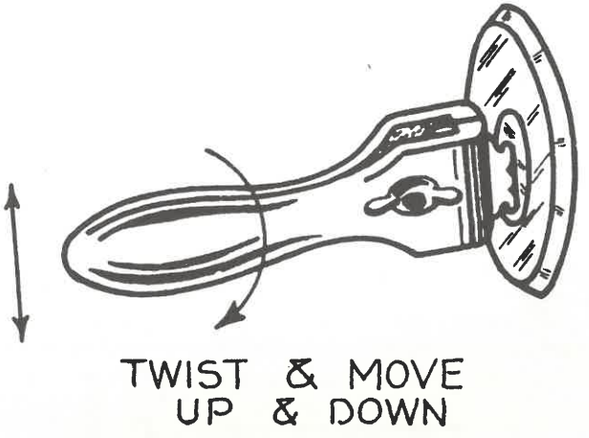

Fig. 29—The Blank, Firmly Gripped, Is Twisted and Rocked

time. FILE ONLY ONE CUT AT A TIME. Continually insert and try for an impression after each cut, filing straight down on the blank until no further impression is obtained. THEN STOP FILING ON THAT CUT!

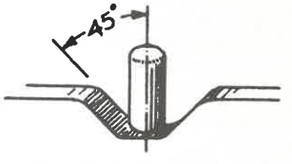

Fig. 30—Correct Angle and Appearance for Cut

Two factors may be responsible for stopping the impression: One, the pin probably will have reached .the shear line, no longer binding against the wall of the upper chamber. Two, as the pin drops deeper into the file cut, the pressure on that pin automatically eases. But in the meanwhile the strain of the turning pressure falls on the next longest pin.

All slopes should be held to as close as a 45 degree angle as possible (Fig. 30).

Thereupon the same procedure must be followed on the new location. If the pin stops marking as a result of the second reason, it will begin to mark again as soon as it becomes the pressure point once more. This process is continued until all of the cuts have been made. Eventually the blank is filed until every pin reaches the shear line, allowing the newly formed key to turn. Smooth, effortless turning of the key is obtained by carefully trimming the cuts with light strokes where minute impressions still appear.

When a cut has been filed too deep, the upper pin or driver drops

into the lower chamber. The driver then binds against the upper wall in the same fashion as a lower pin, causing an impression. To avoid this situation, STOP FILING THE CUT WHEN THE MARKING CEASES!

A variation of the above method is very popular among locksmiths. Instead of inserting the blank in a hand vise, a steel rod is slipped through the key ring hole of the blank. The blank is inserted in the cylinder and torsion is applied to the steel rod as shown in the illustration. The blank is tapped on the upper and lower edges (Fig. 31). The impressions that are thus obtained are clear and distinct.

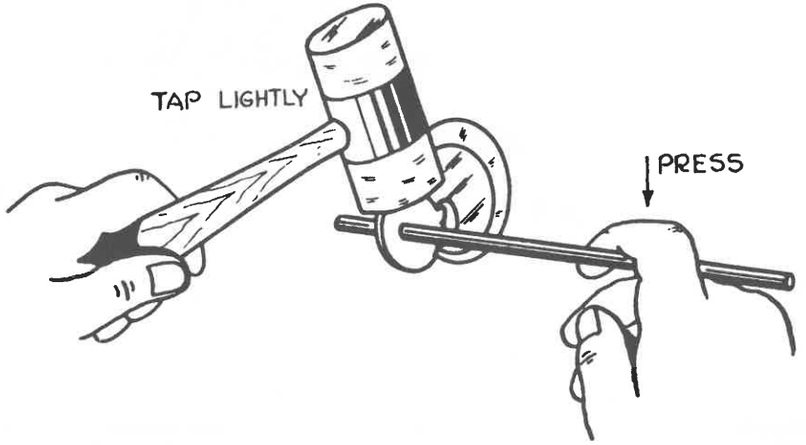

Fig. 31—Using Steel Rod and Plastic Hammer to Obtain Impressions

Another method that has been gaining in popularity is the "Pull-Out" process. Instead of working the blank up and down, or tapping it on the head, this system is based on the principle of pulling out the key blank from the cylinder about a sixteenth of an inch while a turning pressure is being exerted (Fig. 32). The pins make their marks on the slopes of the file cuts as shown in the illustration (Fig. 33).

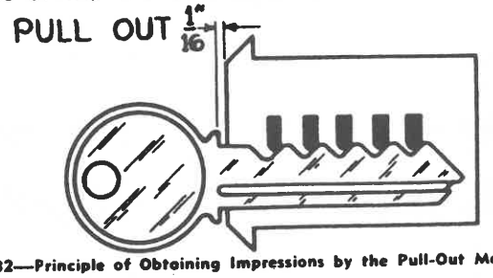

Fig. 32—Principle of Obtaining Impressions by the Pull-Out Method

When using this system, however, the blank has to be pre-cut so that the pins have a slope upon which to make their impressions.

In preparing a key blank for this method, it should be remembered that if the starting cuts are too deep, the shorter pins in the lock may drop below the shear line, and sabotage the effort! In some

cylinders, the shortest pins rest on the face of the bit in order to reach the shear line. For the sake of convenience, locksmiths call this a "zero cut." A very meager starting cut is therefore made on all blanks. In practice these cuts are nothing more than slight file marks to indicate the spacing of the tumblers in the lock.

This system should be practiced by the beginner with a cylinder

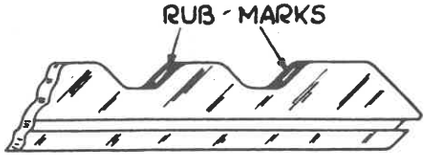

Fig. 33—Appearance of Impression Marks

set up with only two pins. Additional pins are added as skill increases. The goal should be to fit a common five or six-pin cylinder by this method.

In other cylinders, the shortest pins rest in regular cuts, commonly referred to as "number one" cuts. The depth of the number one cut varies with the type of cylinder being fitted. Whereas one manufacturer's number one depth is .025" deep, another's may be only .015" deep.

To save time, the locksmith precuts his blank, since he knows that no pin will be shorter than the zero or number one cut. The following list indicates the popular cylinders by the manufacturer's name

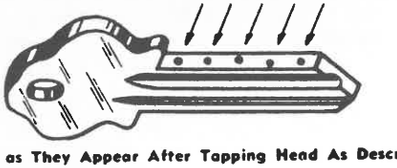

Fig. 34—Spacing Marks as They Appear After Tapping Head As Described in Text

and specifies whether to begin an impression job with a zero file mark or a number one cut. The decimal after the name indicates the micrometer reading from the bottom of the cut to the base of the key bit. When a zero cut is to be used, the letter "O" will appear after the name:

STARTING MEASUREMENTS FOR PIN TUMBLER BLANKS

Barrows	.320	Penn	.355
Best	0	Reading	0
Clinton	0	Russwin	.317
Corbin, P. & F.	0	Sargent	.330
Eagle	.322	Segal	.310
Ilco	0	Large Yale	0
Lockwood	.320	Yale (auto 1937 up)	.255
Master	0		

These readings have been obtained by measuring the depths of original keys. These measurements are not published by the manufacturers, and may be varied occasionally by them to maintain the

security of their locks. They are published here for a general reference only.

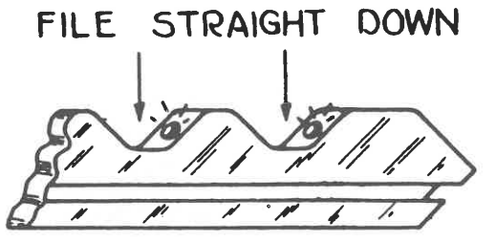

Fig. 35—File Toward Base of Bit Regardless of Position of Impression Marks

To obtain the correct **spacing** for the starting cuts, insert the key in the cylinder and tap the upper and lower edges of the head with a small mallet or hammer handle while applying a torsion pressure to the blank. All of the pins will mark the bit in some degree (Fig. 34).

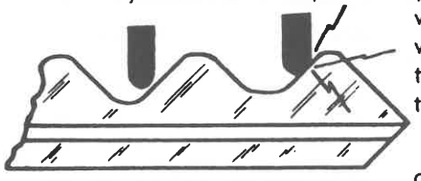

Fig. 36—When This Situation Occurs, It Is Permissible to File at Shallower Cut

Those who have a code machine available can precut their blanks quickly and easily. Depth keys are also excellent means of precutting a key blank because the number one depth key is a duplicate of the precut blank to be used. Merely make a copy and proceed with the work.

The impressions that are obtained by the pull-out method are on the slopes of the cuts . . . but the filing is always straight down toward **the base of the key** (Fig. 35). As the cut gets deeper, it also gets wider. When this occurs, the blank has to be pulled further out of the cylinder in order to make the impression on the slope. It can be seen, therefore, that in some cases, other pins will make deep impressions on the other slopes. When this occurs, it is permissible to start to file the other cuts (Fig. 36).

Pull-outs are accomplished in the fashion shown in Figure 37. Notice that the twisting or torsion pressure is maintained with the hand vise, while the screwdriver pries back the hand vise about a sixteenth of an inch. Twisting the screwdriver, instead of pushing or prying, permits better control over the pull-out.

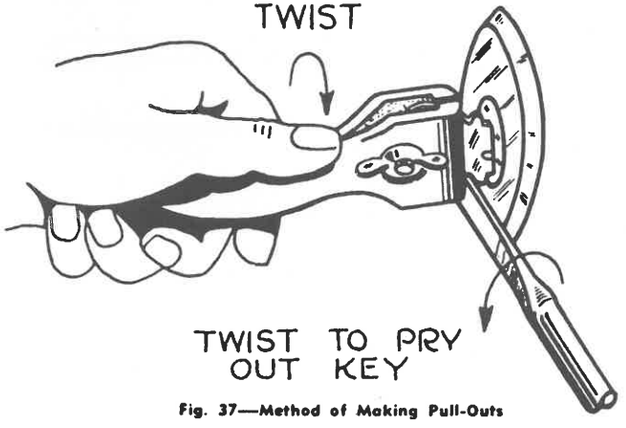

Fig. 37—Method of Making Pull-Outs

A special tool is available to eliminate the need for a hand vise and screwdriver. This tool resembles a saw set. It has a vise in which the blank is secured by a pin through the key ring hole. The pull-out is accomplished by squeezing the handles, causing a movable pin to push the blank away from the face of the cylinder (Fig. 38). While this tool is by no means essential, it is very convenient.

WAFER TUMBLER CYLINDERS

Up to now, no mention has been made of wafer tumbler cylinders. The same principle of impression fitting can be applied to this type of lock. However, because of the fact that the wafer tumbler straddles the bit of the key, it does not lend itself to forming sharp impressions. This is overcome by filing the blank at an angle so that the resulting knife edge can take the impression easily (Fig. 39).

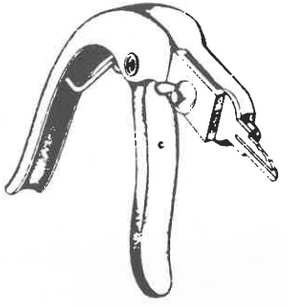

Fig. 38—Impression Tool

Some double-sided wafer tumbler cylinders often can be fitted in the same fashion. But the job is more difficult than on single-sided keys because of a greater number of tumblers, and the constant effort of observing both sides of the key. It is a technique that is developed with much practice and patience.

It should be noted here that Briggs and Stratton side bar locks as used on General Motors cars from 1935 upward are not fitted by the impression system. Nor are the double-sided keys made by the same company for 1934 model cars made this way. Other methods for servicing these types are employed.

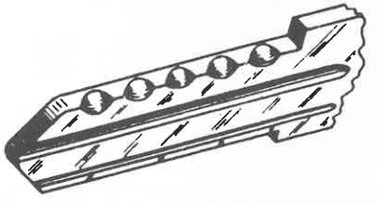

Fig. 39—Filing Blank for Wafer Tumbler Impressions

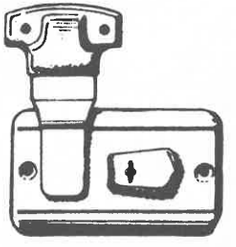

Fig. 40—Hand Luggage Locks

HAND LUGGAGE LOCKS

Although trunk locks are fitted by making the keys from the number that appears on the lock, hand luggage keys are usually made by impression. In most cases, hand luggage locks are of the warded type, or a very simple lever type (Fig. 40). The proper blank filed according to the directions found under double-sided warded padlocks will fit most of the flat double-sided suitcase locks.

Drilled barrel keys, as used by the push-in type of suit case lock, will trick the locksmith unless he knows that the hole in the key has to be drilled deep enough to allow it to enter all the way into the lock.

The illustration (Fig. 41) shows how a piece of wire, or a toothpick, is used as a gage for the hole.

In fitting a key to a suitcase lock, great care must be exercised to prevent forcing of the thin metal mechanism by turning too hard.

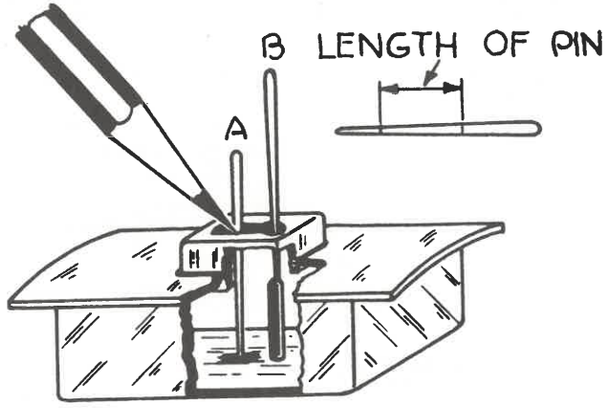

Fig. 41—Gaging Depth of Pin Hole

Many a suitcase lock has been ruined by rough handling. If the lock doesn't operate by reasonable turning pressure, the probability is that the key has not been filed enough.