

Study Unit 2

Introduction to Locks and Keys

Preview

This study unit will introduce you to the wide variety of locks, keys, and security devices that locksmiths see every day. We provide many illustrations and diagrams to make your learning easier and more enjoyable. At the end of this unit, you'll perform your first hands-on exercise with the cutaway padlock included in this package of materials.

When you complete this study unit, you'll be able to

- Describe the simple mechanics of how locks work
- List the three basic parts of a key-operated lock
- Identify the principal parts of a key
- Name the four main types of keys
- Define key blank
- Discuss the four main types of lock mechanisms
- List at least seven applications for key-operated locks
- Name the four factors that affect how well a lock works
- Describe several professional locksmithing skills and the situations when these skills are needed
- List the basic tools that a locksmith uses

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Introduction to Locks and Keys

HOW LOCKS WORK

The First Known Locks

A *lock* is simply a mechanical device for securing a door so that only a key or a combination can open it. This study unit will introduce you to a variety of common locking devices and the basics of how locks work. We'll also discuss some standard locksmithing tasks and the tools used to perform them. Let's begin our discussion of locks and keys with a brief look at the history of locks.

For thousands of years, people all over the world have been using locks to secure their homes and valuables. The oldest known lock in existence was found in the ruins of a 4,000-year-old palace near Egypt. Amazingly, this ancient wooden lock is of a very similar design to the pin tumbler locks we use today. Instead of a key, however, the Egyptian lock uses a wooden opener that looks something like a toothbrush with pegs. Figure 1 illustrates the operation of the Egyptian lock.

The Romans

In later years (about 2,000–3,000 years ago), the ancient Romans introduced the first metal locks (mostly iron locks with bronze keys). The locks had simple mechanisms and were easy to pick open. So, Roman designers attempted to improve security by concealing the keyholes beneath ornamentation. The Romans designed the first padlocks in their area of the world (the Chinese invented a padlock independently in the East at about the same time). The Romans were also the first to make small-sized keys—in fact, Romans sometimes wore keys on their hands as rings (Figure 2).

FIGURE 1—This 4,000-year-old Egyptian lock used a pin tumbler mechanism similar to a modern lock.

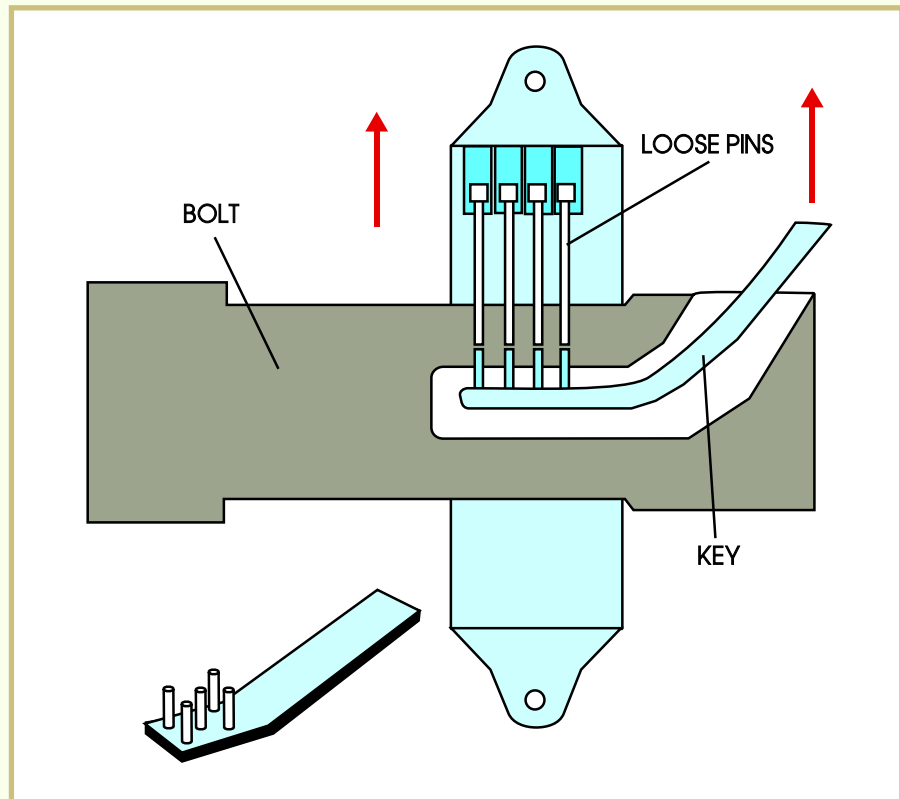
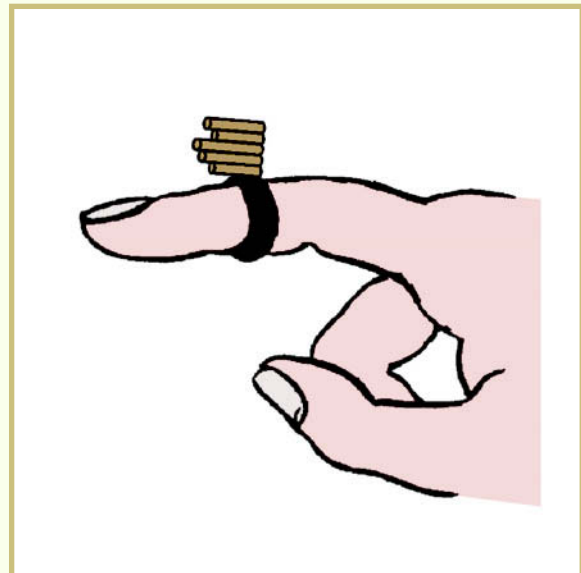


FIGURE 2—A Roman Ring Key



The Middle Ages

During the Middle Ages, as metalworkers gained new skills, the outward appearance of the average lock changed. Most locks were elaborate, beautifully decorated, and cleverly designed works of art. However, few real advances were made in improving lock security.

The people of the Middle Ages paid more attention to chest or box locks than to door locks. Many wealthy people kept money, jewelry, and other valuables locked in chests. One technique for securing a money box involved placing several locks on the box — perhaps as many as 20! Another technique introduces hidden keyholes, false keyholes, and other devices in an attempt to make locks harder to open. One locking device even included a spring-loaded knife that would pop out and injure a thief if tampered with!

The Nineteenth Century

Lock designers and metalworkers continued to develop their skills. By the time of the Industrial Revolution of the nineteenth century, the lock industry had expanded greatly. Many new lock designs were patented during this period, each offering improved security. The most important lock invention of the time was the patented device made in 1848 by the American inventor Linus Yale, the pin cylinder lock. The pin cylinder lock, also known as the Yale lock, was based on the same principle as the ancient Egyptian lock we discussed earlier. The special design of the lock allowed for an almost unlimited number of key variations, which made the lock very difficult to pick. While the original Yale-type lock has been improved upon over the years, its design is essentially the same as it was 150 years ago.

Modern Times

As you've seen, locks have been used since ancient times to protect homes and property from intrusion and theft. Today, we use locks to secure almost everything—doors, gates, windows, cars, drawers, cash boxes, vending machines, safes, and even bicycles! In addition, many new electric and electronic security devices have been developed. A modern locksmith may service many different types of locks in just one week of work. Therefore, locksmiths generally try to familiarize themselves with all kinds of security products, even though most specialize in one or two skills.

The Importance of Using Correct Terms

One of the best ways to gain locksmithing knowledge is to become familiar with locksmithing terms. As you learn the terms and phrases of the locksmithing industry, make them part of your everyday vocabulary. The better you understand the language of locksmiths, the better you'll understand what you read and hear about locks. In addition, by learning the locksmithing language, you'll be able to talk to other professionals, which is one of the most important ways to learn more about any field.

We included a glossary or dictionary of locksmithing terms in your first shipment of study materials. At any time during your reading, be sure to look up any unfamiliar words. This is the fastest way to learn new words and the best way to refresh your memory. We strongly encourage you to get into the "glossary habit."

Now, let's take a closer look at some locks you'll see every day as a professional locksmith. Have your glossary ready for reference! The first type of lock we'll discuss is the ordinary key-operated lock.

Key-Operated Locks

Basic Construction

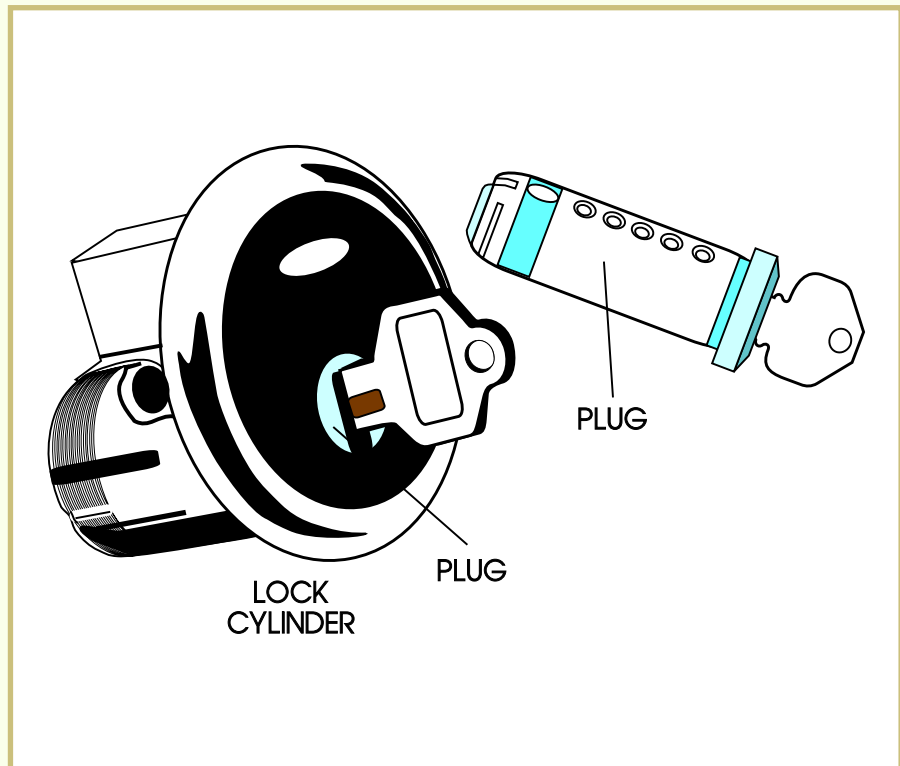
The term *key-operated lock* simply means any type of lock that a key opens. (Note: Not all locks are opened by keys—some are opened by a combination of numbers, and some by electrical switches. We'll discuss these types of locks shortly.) The most common use of key-operated locks is in residential doors.

A key-operated door lock has these three main parts: (1) a *plug* and the *cylinder* that surrounds it, (2) a *latch* or *bolt*, and (3) a *key*. Let's look at each of these parts separately.

Plugs

The *plug*, and the *cylinder* that surrounds it, is the central assembly of a key-operated lock (Figure 3). The plug is the tube, which contains the small parts that operate the bolt or latch. The cylinder is the tube assembly that surrounds and holds the plug. The cylinder holds the small parts firmly in the plug and prevents them from spilling out.

FIGURE 3—This illustration shows a lock cylinder that contains a plug, and a view of the plug when it's removed from the cylinder.



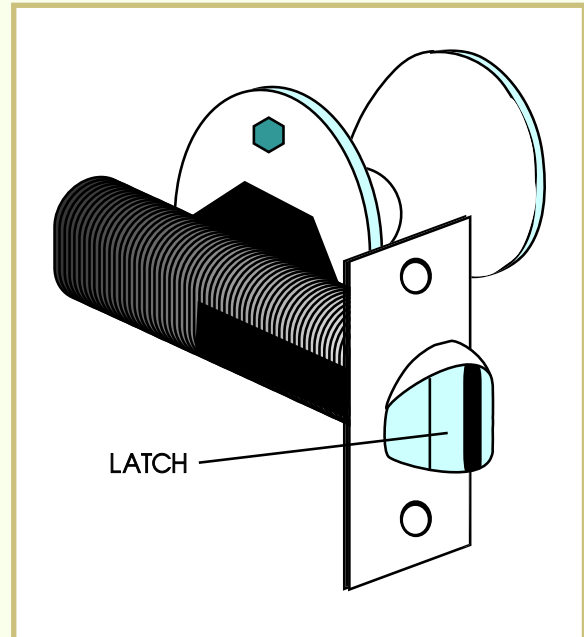
The *keyway* is the “tunnel” in the plug that a key slides into. The inside of a keyway isn’t completely smooth. Instead, the keyway is grooved and notched to allow only the correct blank to enter. When you insert the correct key into the keyway, the small parts inside the plug move in such a way that the plug is freed to turn. As you turn the key, you’ll turn the plug with it, locking (or unlocking) the door.

Some key-operated locks have more than one cylinder. For example, if you want to be able to lock a door on either side with a key, you can install a *double-cylinder lock*. You’ll often find double-cylinder locks on the doors of a business.

Latches and Bolts

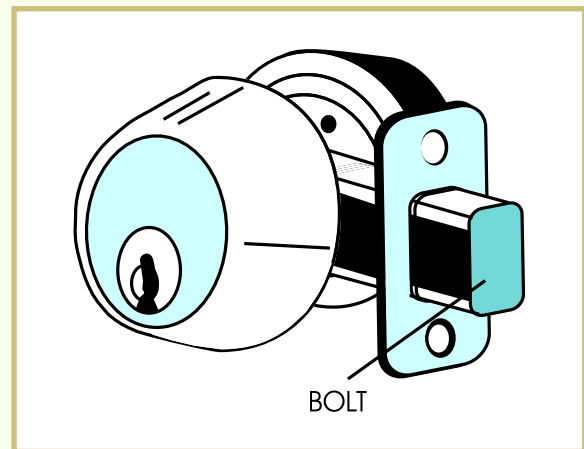
A key-operated door lock may have a latch, a bolt, or both. A *latch* is a piece of metal that protrudes out of the lock and fits into a recessed space in the door frame (Figure 4). This recessed space is a *strike*. The end of the latch is cut at an angle and is mounted in front of a spring. As the door closes, the latch contacts the strike, presses against its spring, and snaps into place in the strike. This leaves the door securely closed, but not locked. To open the door, you simply turn the doorknob.

FIGURE 4—A Typical Door Latch



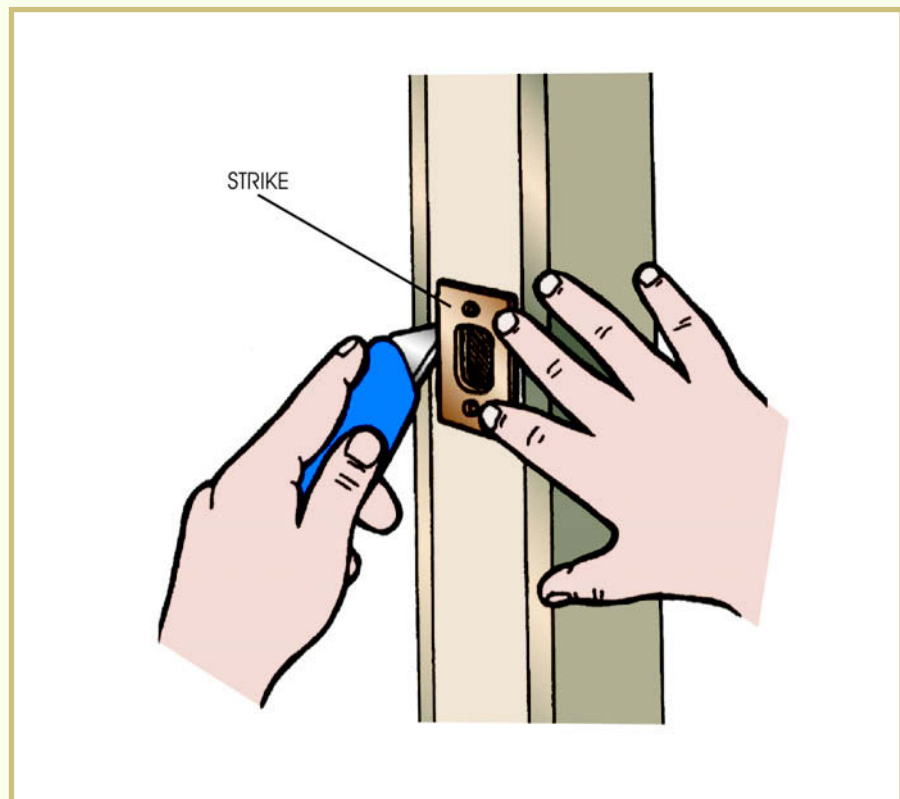
A *bolt* is also a strong piece of metal that protrudes from a lock to fit into a strike (Figure 5). However, a bolt has a squared-off end and is usually longer than a latch, so it fits more deeply and securely into a strike. Also, a bolt isn't mounted with a spring. Instead, a bolt is thrown into the strike either by turning a *thumbpiece* by hand, or by using the key. When a bolt is in place, a door is both securely closed *and* locked. The door can't be opened by just turning the doorknob; the bolt must be withdrawn from the strike first by using a key or turning the thumbpiece.

FIGURE 5—A bolt has a squared-off end to fit deeply and securely into a strike.



The strike is a vital part of the security of any door lock. A strike is a molded metal piece that's fitted into the door frame and secured by screws. However, a strike is only as strong as those screws; if the screws are weak, the lock can be defeated by simply kicking the door in. The most secure strikes are embedded deeply into the door frame, adding strength to the entire locking system (Figure 6).

FIGURE 6—This figure shows a typical strike mounted in a door frame.



Keys

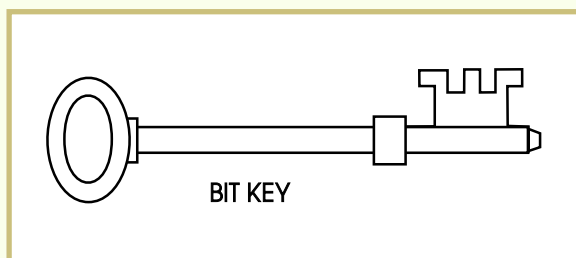
A *key* is simply the small, shaped piece of metal used to open a lock. There are five basic key types, and you're probably familiar with most of them. The four basic key types are

1. Bit keys
2. Barrel keys
3. Lever keys
4. Cylinder keys

Each of these key types goes with a certain type of lock. As you gain locksmithing knowledge, you'll quickly learn to identify locks by the types of keys used with them.

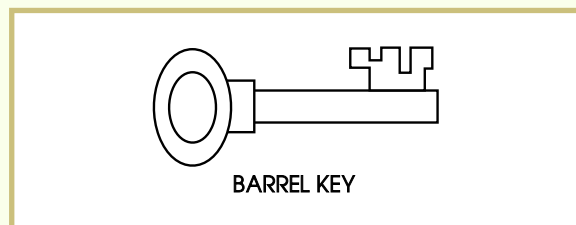
The *bit key* (Figure 7) is the oldest type of key and was once common for front doors. If you live in a very old home, you may still use a bit key for certain interior doors (closets, attic and basement doors, cabinets, etc.).

FIGURE 7—The oldest type of key still in use today. The bit key was also known as a skeleton key.



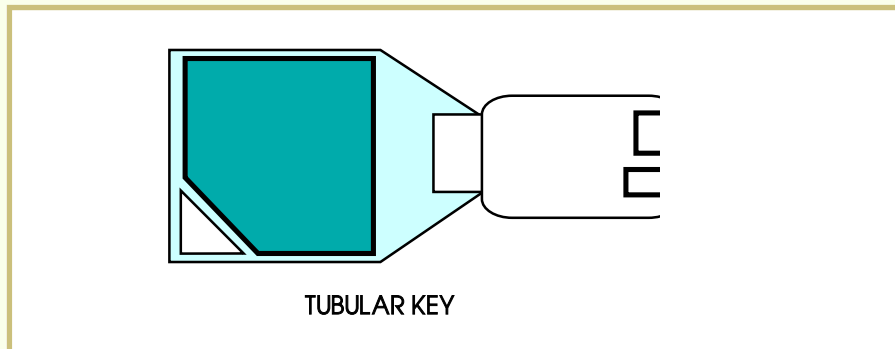
The *barrel key* is a variation of the bit key, and like the bit key, is old-fashioned and seldom used anymore. Barrel keys are round and hollowed out at the end (Figure 8). We use them to open china closets, interior doors, and some older padlocks.

FIGURE 8—Barrel keys are a hollow variation of the bit key.



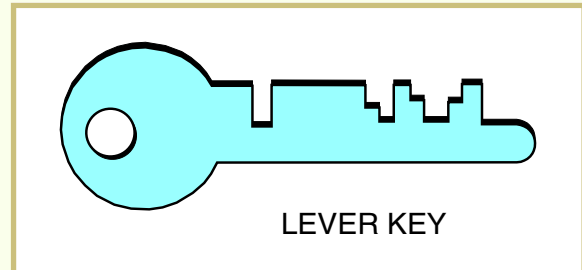
One modern version of the barrel key is the *tubular key* (Figure 9). Tubular keys are short, round, and hollowed out like the barrel key, but they function a bit differently. We use tubular keys in the locks on vending machines, coin-operated laundry machines, and computers.

FIGURE 9—We use tubular keys with vending machine locks and computer locks.



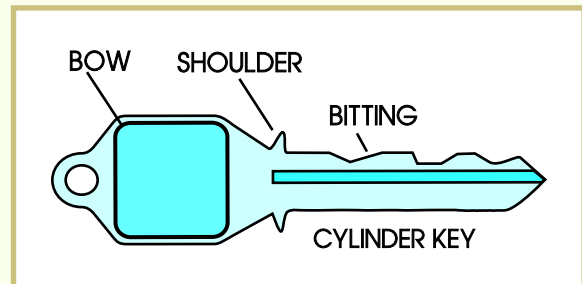
Lever keys are made from thin, flat pieces of steel (Figure 10). These flat keys have no grooves; they're completely smooth on both sides. We use lever keys for some small padlocks and also for safe-deposit box keys.

FIGURE 10—Lever keys have no grooves— they're completely smooth and flat.



The most common type of key used today is the *cylinder key* (Figure 11). If you look on your own key ring now, you'll probably find several cylinder keys. We use cylinder keys for most front door and car locks, as well as padlocks.

FIGURE 11—Cylinder keys are the most common type of key used today.



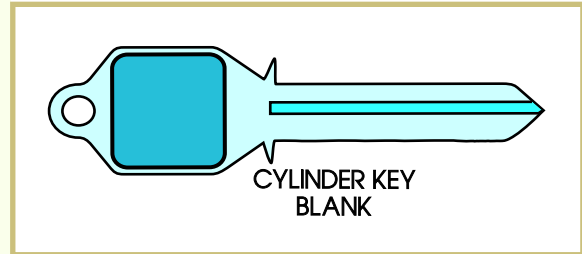
Three parts are common to most types of keys. These three parts are the bow, the shoulder, and the bitting (refer back to Figure 11). The *bow* is simply the handle of a key. Most lock manufacturers have their own distinct and recognizable bow shapes. All keys have a bow.

Just below the bow is the *shoulder* of the key. The shoulder of a key is slightly wider than the rest of the key's length. The shoulder prevents the key from being pushed too far into a lock.

The *bitting* is the pattern of notches cut into the edge of the key. The first notch is always cut just below the key's shoulder. The locksmith can make these notches with a key cutting machine, or by hand with metal files. Most keys have this type of bitting. One exception is the tubular key in which the bitting runs around the circular end of the key.

To make a new or duplicate key for a customer, a locksmith begins with a *key blank* (Figure 12). A key blank is simply an uncut key. All key blanks aren't alike. Each lock will accept only one type of key. A key blank must exactly match the length, width, thickness, shape, and groove pattern of the original key to fit the lock.

FIGURE 12—This figure shows a cylinder key blank.



Lock Mechanisms

Now that you understand the basics about keys, let's take a look at the locks that we use them with. A lock *mechanism* is simply the assembly of parts inside the lock that makes it work. There are only four common mechanisms used inside modern key-operated locks. They are

1. The *warded* mechanism
2. The *lever tumbler* mechanism
3. The *disk (or wafer) tumbler* mechanism
4. The *pin tumbler* mechanism

Let's take a closer look at these lock mechanisms now.

The Warded Mechanism

The *warded* lock mechanism is the oldest type of lock still in use today. The ancient Roman locks we talked about earlier contained warded mechanisms. A warded lock works on a very simple principle. The interior of the lock has protruding ridges called *wards* that prevent the wrong key from being inserted to throw the bolt. Figure 13 shows a lock mechanism with an edge ward. Note that we use bit keys with most warded locks. Figure 14 shows a slot milled on the edge of the key, which allows the key to pass a case ward.

FIGURE 13—A Warded Lock Mechanism Showing an Edge Ward

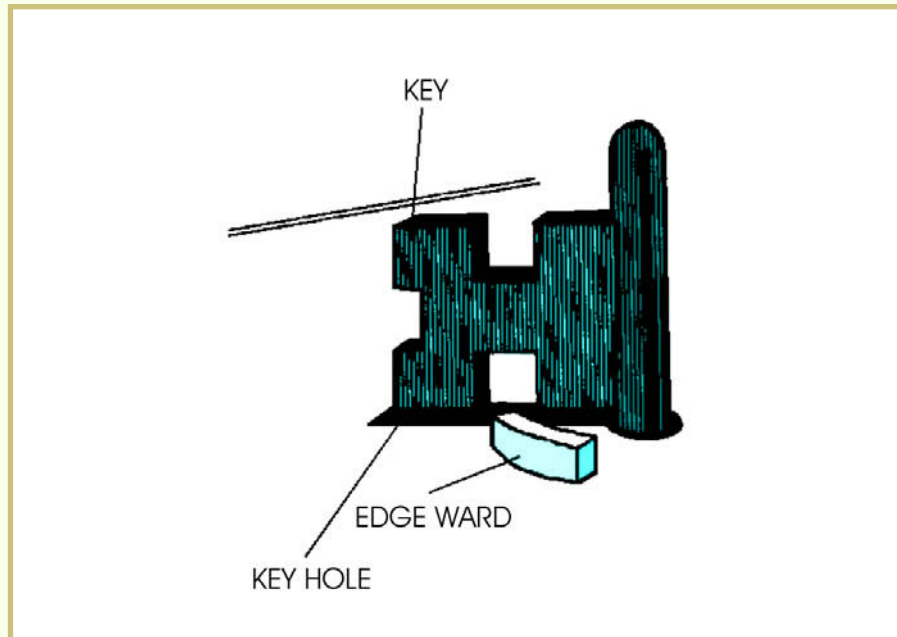
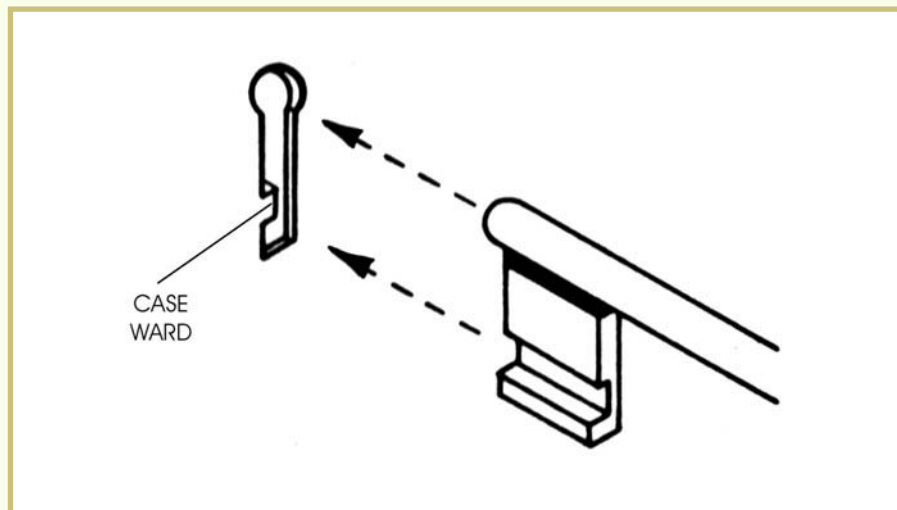


FIGURE 14—A Warded Lock Mechanism Showing a Case Ward

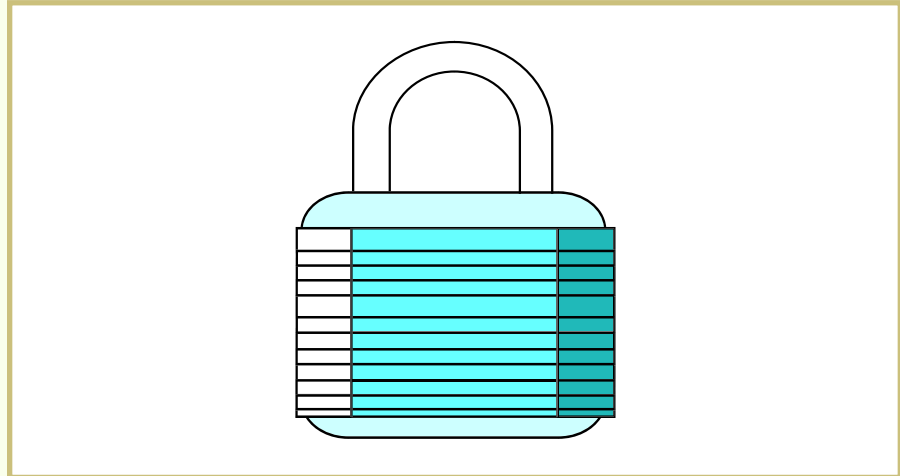


Warded locks were once commonly used as door locks. However, because they're very easy to pick, we seldom use them anymore. However, small warded padlocks are still common. The advantage of simple warded padlocks is that we can use them where sand, dirt, or ice may jam a more complex mechanism (on toolshed doors, toolboxes, in boats, etc.). Modern warded padlocks (Figure 15) don't use bit keys; they use lever keys.

Locksmiths still occasionally see some warded locks in very old homes. However, whenever you see these locks, you

should recommend replacement (or at least reinforcement) with a newer, more secure lock.

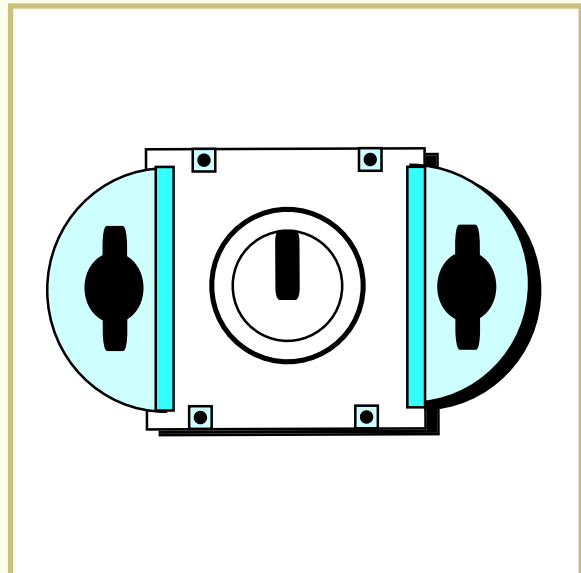
FIGURE 15—This *warded padlock* uses a *lever key*.



The Lever Tumbler Mechanism

Lever tumbler locks (Figure 16) have flat metal plates that must slide into place for the lock to operate. As the correct key is turned, it will move the plates just enough to allow the lock to work. The flat design of the lever lock makes it suitable for use on school lockers, mailboxes, luggage, cash boxes, and safe-deposit boxes. Lever locks are much more difficult to pick than warded locks.

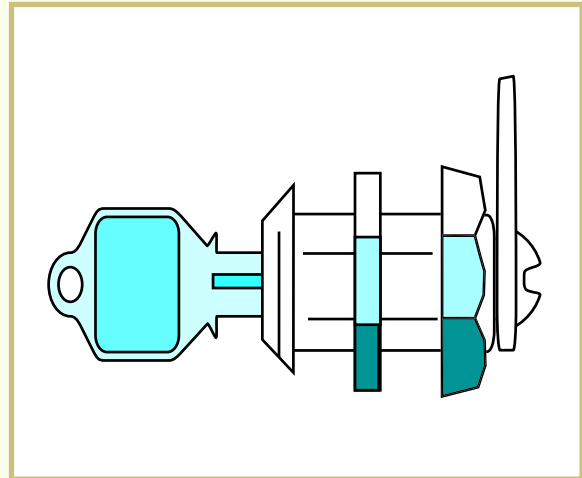
FIGURE 16—We use this type of lever lock on *gymnasium lockers and mailboxes*.



The Disk Tumbler Mechanism

The *disk tumbler* lock mechanism (Figure 17) is designed with a keyway surrounded by a cylinder. The cylinder contains rectangular metal disks that can move up and down. When you insert the correct key into the keyway, the disks are raised to the proper level, and the cylinder is freed to turn, opening the lock. Disk tumbler locks are most commonly used in automobile doors and as desk locks in offices.

FIGURE 17—We use this type of disk tumbler lock on desk drawers.



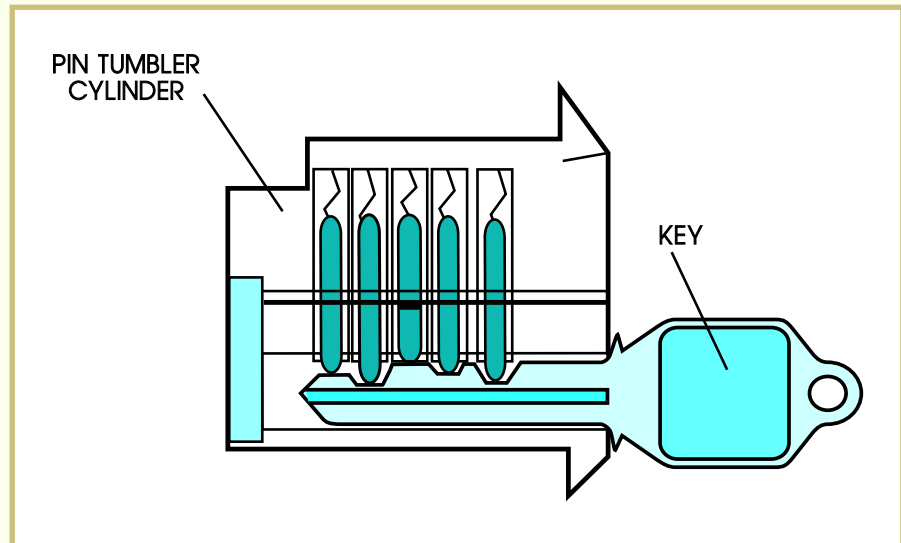
The Pin Tumbler Mechanism

The *pin tumbler* lock mechanism is the most secure in use today. You'll commonly find it in cars and residential doors. The pin tumbler lock, like the disk lock, has a keyway surrounded by a cylinder. Small metal pins align in a row along the length of the cylinder. The pins are of different heights, and can move up and down freely. When you insert the correct key into the keyway, the pins move to the correct height, the cylinder turns, and the lock opens (Figure 18).

Pin tumbler locks are very secure and are difficult to pick, though not impossible. For this reason, a special type of high-security pin tumbler lock is also available today. Such locks contain four rows of pins and require a special type of key (usually a dimple key) to open. High-security pin tumbler locks are virtually impossible to pick open.

As we mentioned before, keys aren't the only way to open locks. Let's now discuss combination locks.

FIGURE 18—This figure shows an interior view of a pin tumbler cylinder with the key inserted.



Combination Locks

Combination Lock Construction

A *combination lock* is a type of lock that you open by dialing a series of numbers instead of inserting a key. Combination locks have a numbered dial face with a knob. You turn the knob both clockwise and counterclockwise to certain numbers on the dial. Dialing the proper series of numbers releases the lock's internal mechanism, opening the lock's shackle. Figure 19 shows a typical combination padlock.

FIGURE 19—A Combination Padlock



The main parts of a combination padlock's inner mechanism are the *wheels* or *tumblers*. Most lock combinations contain three tumblers and a dial with its knob.

When you turn the knob on the dial face, you're actually turning only the first tumbler until it properly aligns with the second tumbler. Now, these two tumblers turn until they align with the third tumbler. Now, all three tumblers will turn as you rotate the dial knob. Once all three tumblers line up correctly, the lock will open. While some combination locks have more than three tumblers, they all operate on this same basic principle.

Combination locks provide greater security than keyed locks. A three-tumbler combination lock is practically impossible to defeat by trying random combinations. There are up to a million possibilities, and only one correct one. A combination lock with more than three tumblers will have even more possible combinations. That's why you find combination locks on safes and bank vaults.

Another advantage of combination locks is that you can change the combination easily (except in the most inexpensive padlocks). To maintain security, companies and stores frequently change the combinations on their safes when employees leave.

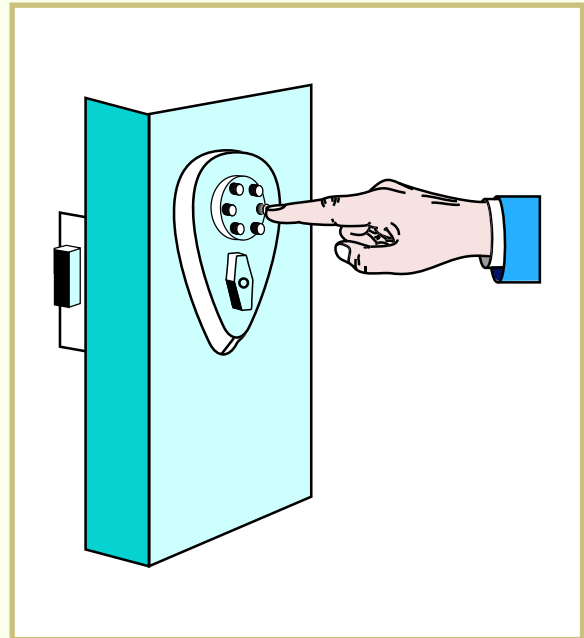
Types of Combination Locks

There are many types of padlocks, door entry systems, and safes that use a combination lock. Some combination locks, such as those on safes or rooms that contain classified information, are connected to automatic lock timers. The time clock is set for a particular time at which the lock opens or allows you to use a combination to open the safe. Such locks are *time locks*.

Time locks provide a double-lock security system. In banks, for example, the timers may be set to go on at 5:00 P.M. each day and off at 8:00 A.M. In businesses, time locks unlock all doors automatically at a certain time, eliminating the need to have a security officer open each door for employees.

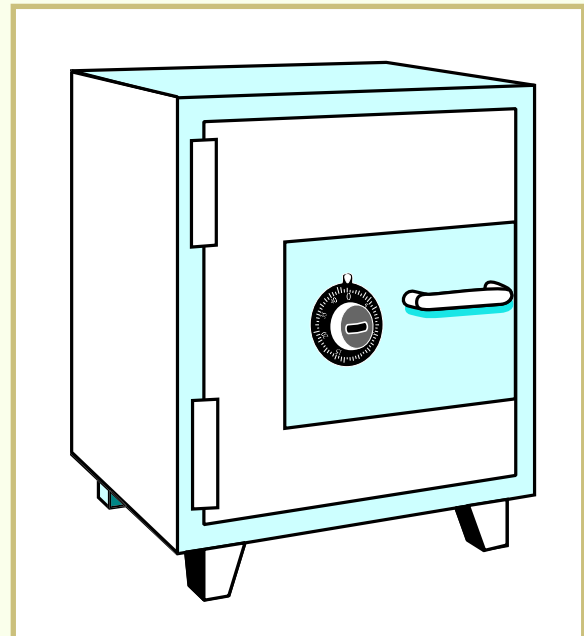
Push-button combination locks (Figure 20) require the user to press one or more buttons together or in a sequence. The correct pressing of the buttons opens the lock. These locks are mechanical—they don't use electricity to operate.

FIGURE 20—This illustration shows the operation of a push-button combination lock.



Most homes, businesses, and banks use a variety of safes of all sizes. Models are available that install in floors, walls, or under counters. In addition, specialty safes can store and protect rifles, pistols, and paper documents. Most safes are made of thick steel and are insulated with a fire wall (Figure 21). A business safe or vault that's fire-resistant as well as secure protects the contents from all kinds of destruction.

FIGURE 21—Homes and businesses commonly use this type of standing safe.



While safes will require occasional repairs, cleaning, and lubricating, the most common service calls for a locksmith are to change safe combinations.

Electric Locks and Electronic Security

Electric Locks

Electrically operated locks and release latches are commonly used on the doors of large office and industrial buildings. The locks typically open with a code number punched into a key pad or with a card key. *The card key lock* operates by inserting a coded plastic card into the door lock. The card has a magnetized strip that actuates the lock. You'll find the card key lock used in many hotels and motels.

Electric locks can provide extra security since they remain locked most of the day. Only authorized employees and security personnel are able to open the locks.

Electronic Security Devices

The rising crime rate and the fear of home burglary has made the installation of electronic security devices a lucrative locksmithing specialty. There are two basic types of alarm systems: local and central.

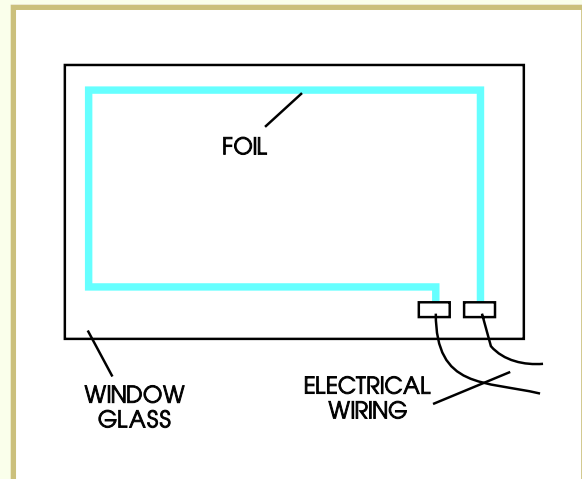
A *local alarm* sounds only at the building where it's installed. This type of alarm can alert neighbors and scare away would-be intruders. *Central alarms* connect to a monitor station owned and monitored by a private alarm company.

Some typical electronic security devices include the following.

Foil. Foil is a metallic ribbon that attaches to glass (Figure 22). When anyone breaks the window, the foil breaks and triggers an alarm.

Pressure mats. Pressure mats are alarm pads placed in doorways, hallways, stairways, and under carpets. The alarm mat contains a flat switch that sets off an alarm when it senses the pressure of footsteps.

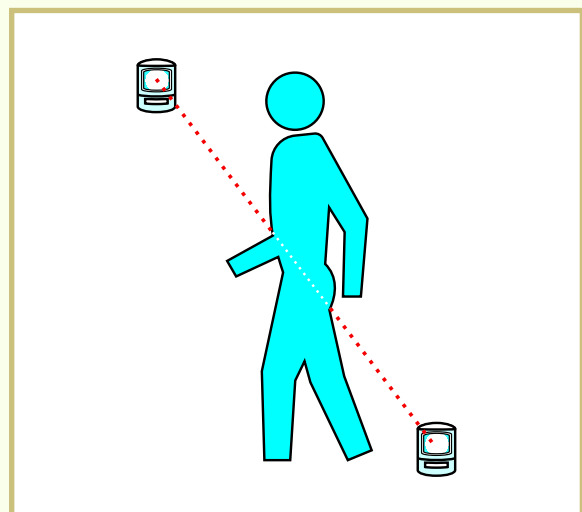
FIGURE 22—This illustration shows the installation of foil in a store window.



Vibration detectors. A vibration detector is a sensor device that feels the vibrations of an attacker on walls, floors, and ceilings. When the detector senses such vibration, the system triggers an alarm.

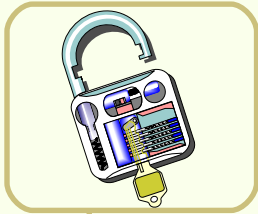
Photoelectric beams. A photoelectric beam device (also called a motion detector) looks like a standard wall outlet and sends beams of infrared light across hallways, rooms, and stairwells (Figure 23). The beams are invisible to the naked eye, but when an intruder walks through the beams, an alarm sounds.

FIGURE 23—If an intruder walks through a photoelectric beam, an alarm will sound.



Panic buttons. A panic button is a device that you would most often find below counters in retail stores. If a robber enters, the clerk or cashier can press the button to sound an alarm.

Now, before proceeding to the next section of the text, take a few moments to test your knowledge of what you've read by completing *Locking It Up! 1*.



Locking It Up! 1

At the end of each section in *Introduction to Locks and Keys*, you'll pause and check your understanding of what you've just read by completing a "Locking It Up!" quiz. Writing the answers to these questions will help you review what you've studied so far. Please complete *Locking It Up! 1* now.

Fill in the blanks in the following statements.

1. A _____ lock is any type of lock that a key opens.
2. The _____ is the tube assembly that surrounds and holds the plug.
3. If you want to be able to lock a door on either side with a key, install a _____ lock.
4. The five basic key types are _____, _____, _____, _____, and _____.
5. The _____ is the handle of a key.
6. The _____ is the pattern of notches cut into the edge of the key.
7. A _____ has a squared-off end, while a latch has an angled end.
8. The four mechanisms used in modern locks are _____, _____, _____, and _____.
9. The _____ lock mechanism is the oldest type of lock still in use today.

Check your answers with those on page 57.

KEY-OPERATED LOCK APPLICATIONS

We use key-operated locks for a variety of purposes. Customers will often ask a locksmith to recommend locking devices for their particular needs. For this reason, you'll need to know more than just how to repair and replace locks. To be able to advise your customers well, you'll need to understand how to best use locks for everyday security.

Locks have six typical uses in everyday security.

1. To prevent entry (an exterior door lock)
2. To provide privacy (a bedroom or bathroom door lock)
3. To secure valuables (a deposit box or safe)
4. To prevent something from being removed from a location (a bike lock)
5. To prevent operation of a device (a car ignition lock or a gun lock)
6. To prevent access to information (a computer lock)

When a customer asks you to recommend a lock, the first thing you must do is determine why he or she needs the lock. If anyone uses a lock improperly (that is, for a purpose other than its intended purpose), the lock will have little or no deterrent value. A *deterrent* is something that prevents a thief or intruder from breaking into a house or stealing property. The *deterrent value* of a lock is simply how well it prevents crimes from occurring. How well a lock acts as a deterrent directly relates to the following four factors.

The type of lock. Most locks are designed for certain purposes. For example, a lock designed to secure a window sash would be worthless if installed on a wooden entry door. We wouldn't use a safe lock on a house door. Likewise, we wouldn't use a padlock to lock a car ignition. These are simple examples, but can you see how important it is that the right type of lock be used for a job? The type of lock used in a particular situation directly affects how well it will act as a deterrent.

The quality of the lock. Poorly designed locks of low quality offer relatively little security since they're easy to force open.

In contrast, *a high-quality lock that's precision-made and properly installed is difficult to force open.*

The quality of installation. You must install locks carefully and correctly according to the manufacturer's specifications to assure security. In addition, check the area on which you're installing the lock for proper strength. For example, it makes little sense to install an expensive, high-security lock on a "paper-thin" door. Thieves won't bother trying to pick the lock mechanism, they'll simply kick in the door! Thus, the way you install a lock (and where) directly affects how well it will prevent crime.

The skill of the potential intruder. All beginning locksmiths must learn that no lock is 100 percent guaranteed to stop a crime from occurring. If thieves are skilled enough and determined enough to get into a place or a thing, they will, and no lock will stop them. They may find some way to force open the lock itself, or they may simply find an alternate way to get in. However, a good lock can slow down a thief and make it more likely that the thief will be caught. Also, a burglar who judges that it's too much trouble to bother with a particular lock will simply move on to a less-protected house.

In summary, to create a proper deterrent to crime, a lock must be of good quality, installed securely, and used only for its intended purpose. Keep these factors in mind whenever you recommend a lock or security product.

Now, let's take a look at some common key-operated locks that are used every day. If you were to look in a lock supplier's catalog or in a hardware store, you'd find key-operated locks and locking devices divided into the following general categories.

1. Residential entry locks
2. Auxiliary door locks
3. Specialty locks
4. Office locks
5. Commercial Locks
6. Auto locks

Residential Entry Locks

A *residential entry lock* is a lock used on the exterior door of a home. One of the most common entry locks sold today is the *lockset*, which refers to any complete door opening set that includes a doorknob, a lock cylinder, a deadbolt, and all the hardware needed for installation.

Most modern locksets contain pin tumbler cylinders. You can install the cylinder directly into the surface of a door (a *mortise cylinder*) or in a doorknob (a *key-in-knob lock*). When a customer desires extra security, you can use both a mortise lock and a key-in-knob lock in the same door. Figure 24 shows a mortise cylinder; Figure 25 shows a key-in-knob lock.

FIGURE 24—Shown is a mortise cylinder, which you install into the surface of a door.

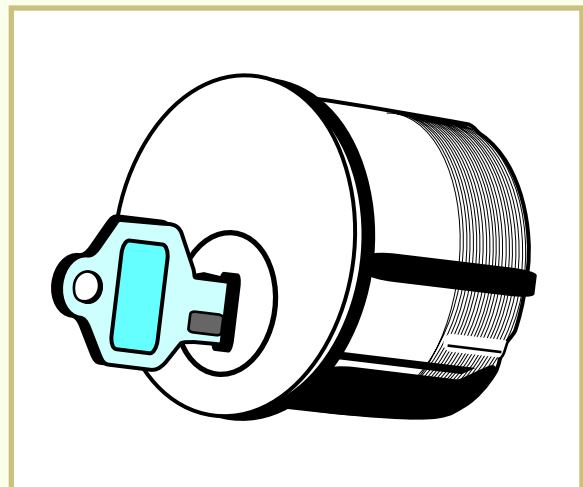
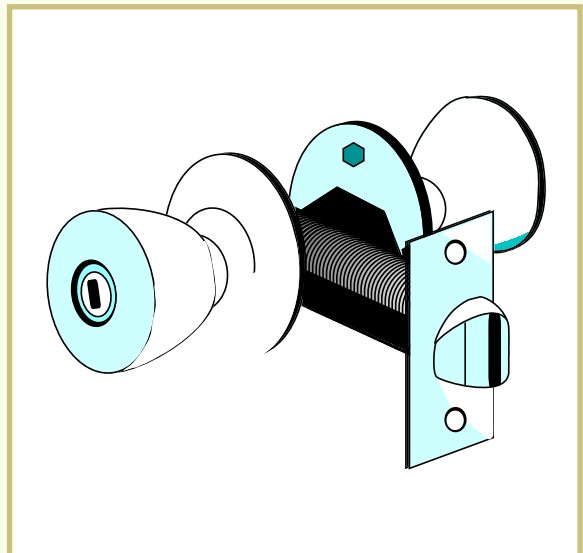


FIGURE 25—A Standard Key-in-Knob Lock.



A standard lockset uses a traditional round doorknob to open the door. However, other types of locksets are available. An *entrance handleset* (Figure 26) is a special type of lockset used for both homes and businesses. To open the door, you have to grasp the handle and the press down the thumbpiece. The *lever lock* (Figure 27) is another type of lockset frequently used in hospitals or on doors designed to allow access to the disabled. The shape of the lever handle makes it easier to grasp than a standard doorknob.

FIGURE 26—*Entrance handlesets are a popular choice when home owners want a decorative alternative to the traditional lockset.*

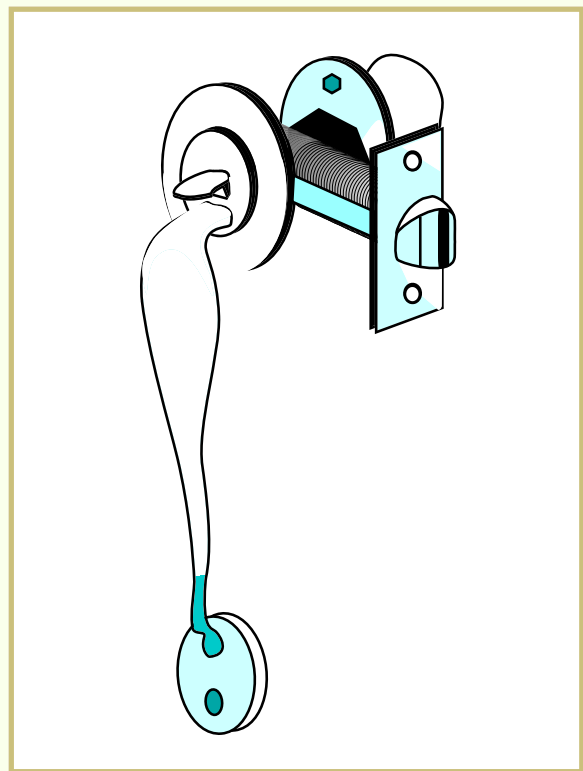
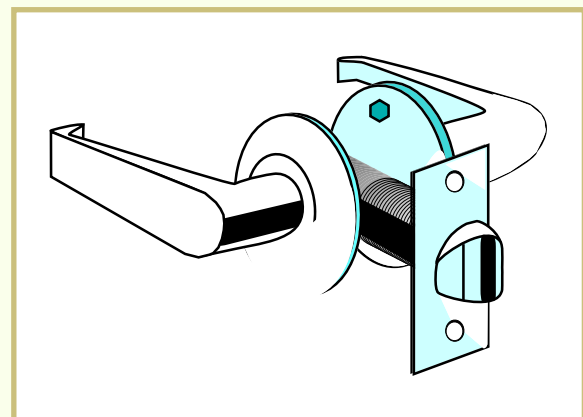


FIGURE 27—*Because the lever handle is easier to grasp than a standard doorknob, lever locks are popularly used in hospitals and facilities for the handicapped.*



Locksmiths occasionally describe door locks by the way they're installed. For example, some door locks fit into a recessed area cut into the door. The recess is termed a *mortise*, so a lock installed in this fashion is a *mortise lock*. In contrast, a *rim lock* is a type of door lock installed on the surface or rim of a door (Figure 28). A *cylindrical lock* is a lock shaped like a cylinder that fits into a tunnel cut into the door (Figure 29). Finally, a *narrow stile lock* is made especially for glass doors with a narrow frame. The term *stile* is the name given to the vertical wooden components of a door.

FIGURE 28—This figure shows how a mortise lock and a rim lock are installed in a door.

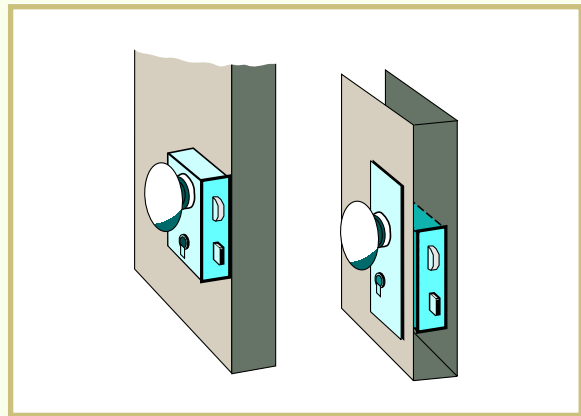
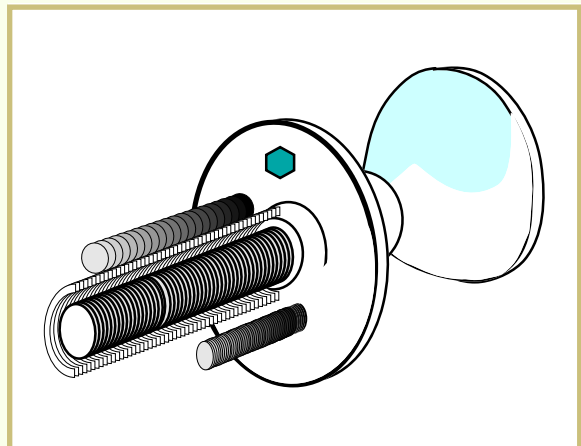


FIGURE 29—A Cylindrical Lock Installed in a Tube Cut Through a Door

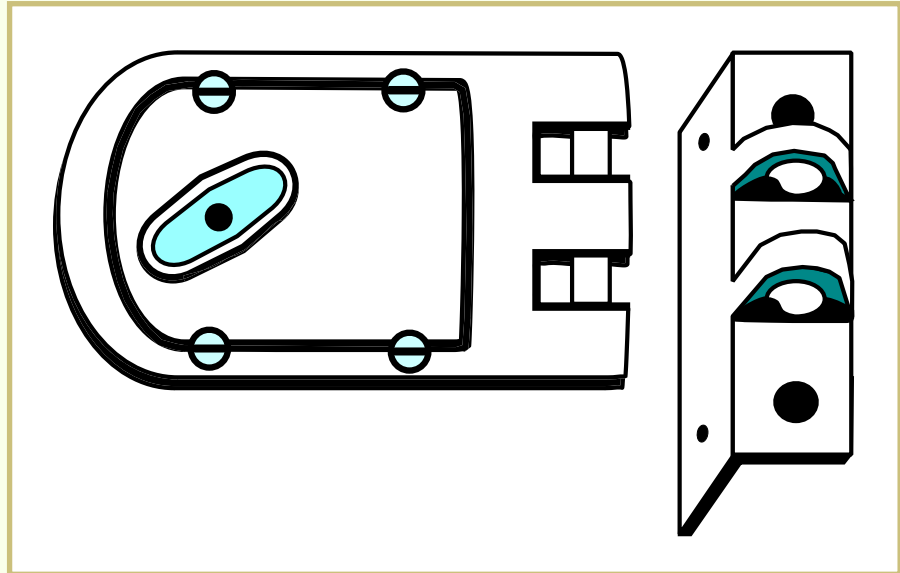


Auxiliary Locks

An *auxiliary lock* is simply an “extra” lock installed on a door to provide backup security. Two common key-operated auxiliary locks are the *tubular deadbolt* and the *turn knob rim lock*. You mount a tubular deadbolt into a horizontal “tube” cut into the edge of a door. Usually, a mortise cylinder is used with the tubular deadbolt. The bolt itself must be moved into position either with a key or by turning the thumb turn from the inside.

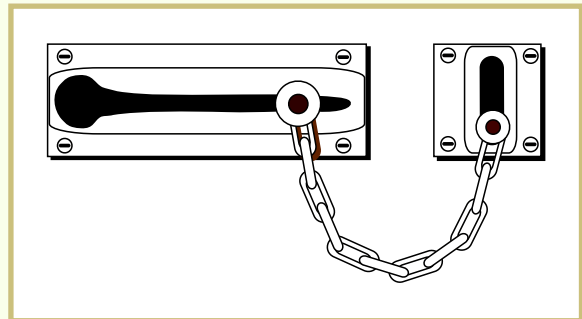
You mount a turn knob, vertical pin-rim deadlock on the surface of a door. You open the lock with a key or by turning the turnpiece (Figure 30). Rim locks are very secure and are resistant to jimmying, prying, and other types of forced entry.

FIGURE 30—A turn knob, vertical pin-rim deadlock is very resistant to attempts to jimmy or pick it open.



Another common auxiliary lock is the *safety chain* (Figure 31). Safety chains may or may not be operated by a key. The safety chain allows you to partially open a door to see out without granting entry to the person on the other side.

FIGURE 31—A Safety Chain

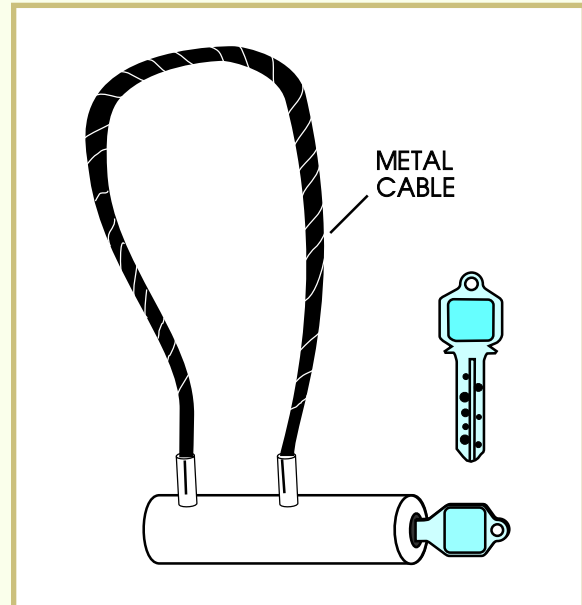


Specialty Locks

The term *specialty lock* applies to a variety of locking devices used for specific security purposes. The mechanisms are no different from any other type of lock, but the overall shape and function of the lock are adapted so that we can only use the lock for one purpose. Some common specialty locks are *padlocks*, *gun locks*, *luggage locks*, *bicycle locks*, *trailer locks* (used

to lock a trailer hookup on a vehicle), *cable locks* (Figure 32), *vending machine locks*, and *ski locks*. A tubular key operates the vending machine. Cylinder keys operate the other devices.

FIGURE 32—A High-security Cable Lock



Specialty locks help prevent the removal of property from a location or they prevent a device from being used. For example, a bicycle lock prevents someone from removing your bike from where you left it; a gun lock fits into the trigger assembly of a gun and prevents it from being fired.

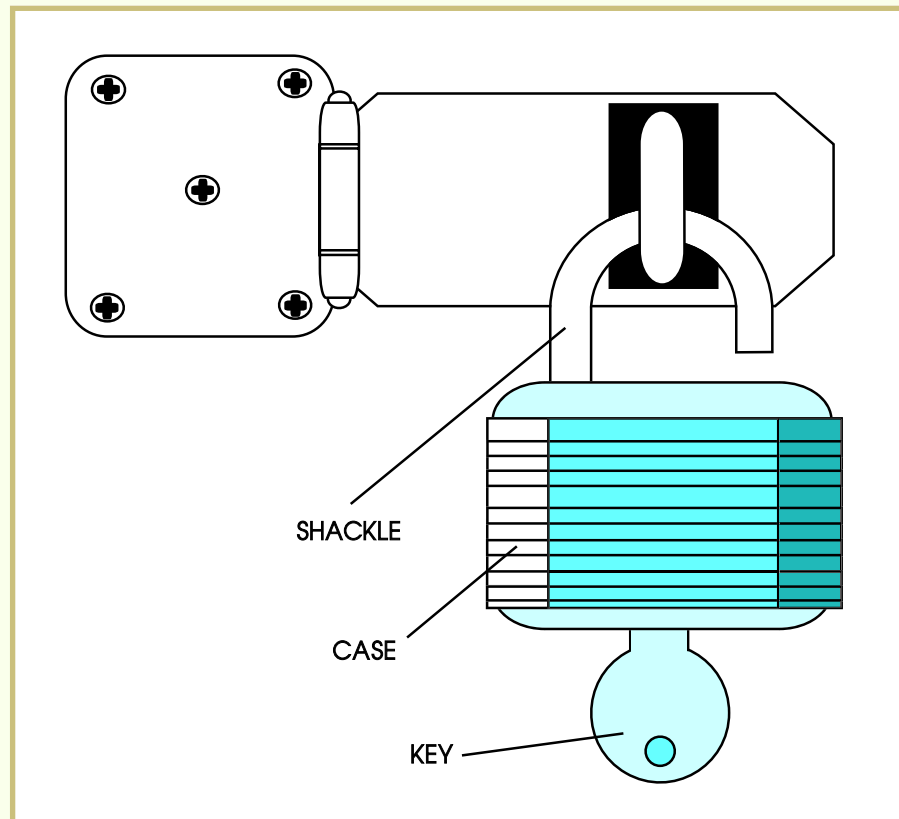
Padlocks are convenient, portable locks used to secure gates, doors on outbuildings, storage areas, and toolboxes. Padlocks come in many shapes and sizes, but they all have three basic parts: the *key*, the *casing*, and the *shackle*.

The casing is simply the outer shell of the padlock. The shackle is a U-shaped piece of hardened steel that extends out of the main body of the padlock. The padlock locks when the shackle is secured inside the lock. A padlock is most effective when it's connected to a solid surface. You can install a hinged metal strap called a *hasp* on a door to provide a place for the padlock to connect to. Figure 33 illustrates the parts.

Office Locks

Office locks include a variety of devices used to secure equipment and documents in office buildings. Because offices

FIGURE 33—This illustration shows the basic parts of a padlock.



contain valuable papers and information as well as property, offices need special locking devices to protect file cabinets, desks, and computer terminals.

The *cam lock* most often locks desk drawers and cabinets. The cam is a rotating piece of metal at the back of the lock plug. The plug itself may be a pin tumbler or disk tumbler mechanism. When in place, the cam forms a physical barrier that prevents a drawer from being pulled out or a cabinet door opened. When you insert the key and the plug turns, the cam at the back of the lock turns also, freeing the drawer or door to open.

A *file cabinet bar* is a common device used in high-security offices with valuable papers and documents (Figure 34). The bar locks in place over the fronts of the file drawers, preventing them from pulling out. When the bar is unlocked, it swings away from the file drawers, freeing them to open.

A *computer lock* is a device found on the front of a computer terminal (Figure 35). When locked with a tubular key, the lock prevents the computer's keyboard from operating. Without the keyboard available to type commands into the computer, an intruder can't gain access to the information stored inside.

FIGURE 34—A locking file cabinet bar physically prevents drawers from being pulled open.

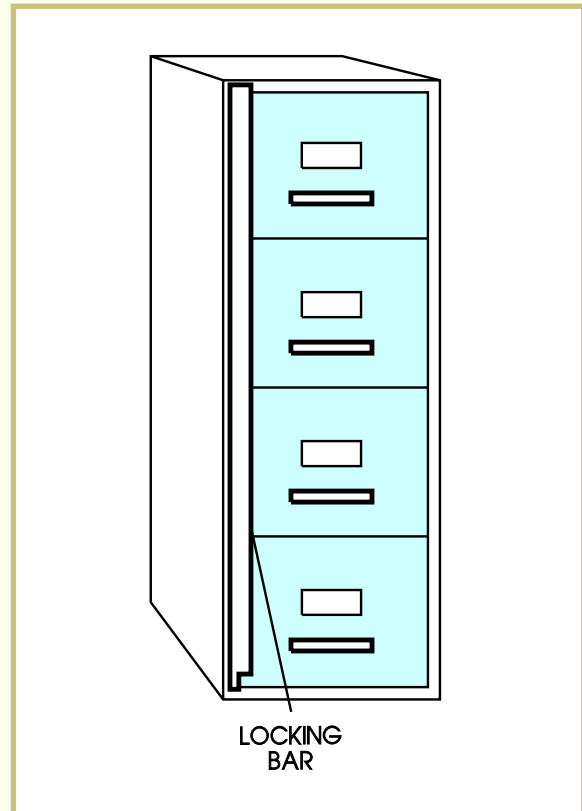
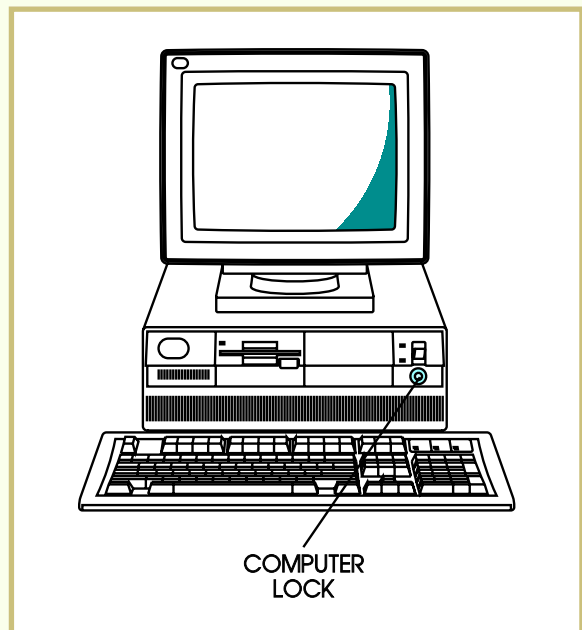


FIGURE 35—The lock on this computer terminal prevents the keyboard from being used.

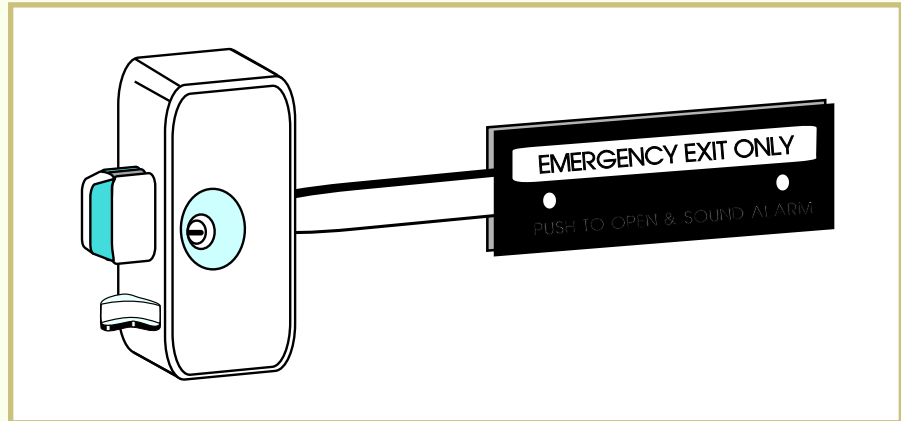


Commercial Locks

Commercial locks are locks used primarily for businesses and large buildings, rather than private homes. Building code

laws in most areas demand that commercial buildings install devices that make it very easy to get out of the building quickly in case of a fire or other emergency. For this reason, most commercial buildings install *panic hardware* on the insides of their doors (Figure 36). Even if a door is locked from the outside, anyone trapped inside only has to lean on the inside paddle or handle to release the door outward.

FIGURE 36—This illustration shows a typical panic bar device.

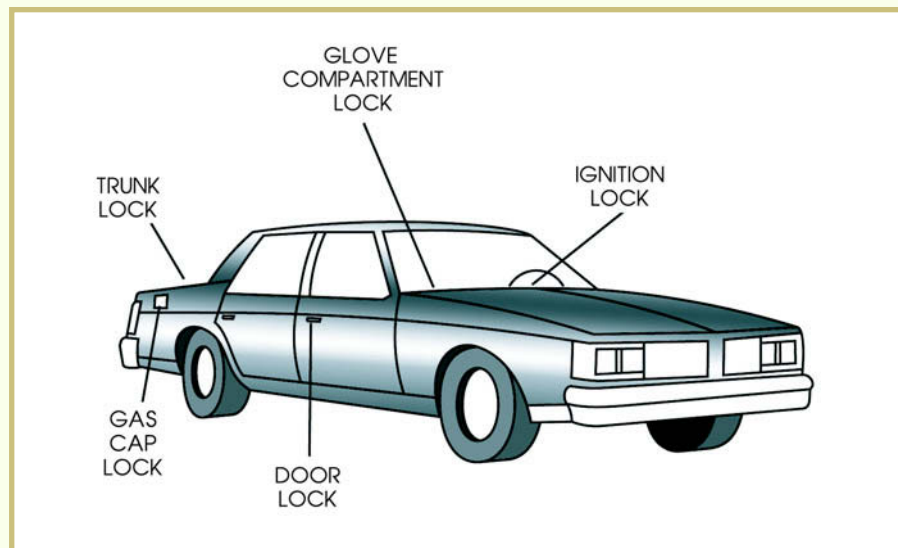


For security purposes, high-security pin tumbler cylinders are often used on commercial buildings. These locks make it very difficult to pick or force open a door.

Auto Locks

The average car may contain as many as five locks: ignition, door, trunk, glove compartment, and gas cap (Figure 37).

FIGURE 37—This illustration shows the location of standard auto locks.

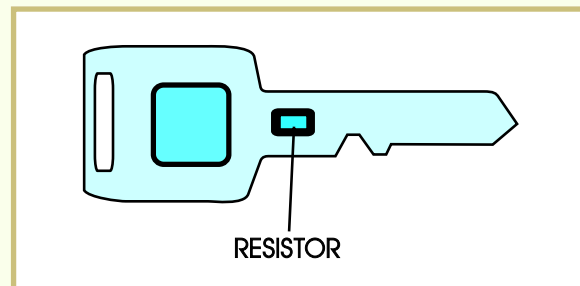


You'll find pin tumbler and disk tumbler cylinder locks most often in automobiles.

The market for vehicle security devices is growing fast to keep pace with rising crime rates. For this reason, many car manufacturers now include vehicle security devices in their cars in addition to locks. A wide variety of products is available for later installation as well.

One well-known security system is General Motor's *PASS*, which stands for *Personal Antitheft Security System*. In the *PASS* system, an electrical resistor chip is embedded in each car key (Figure 38). When you insert the right key into the car ignition, the *PASS* computer recognizes the chip and starts the car. However, when you insert the wrong key or attempt to bypass the system, the computer shuts off the starter and the fuel supply for several minutes.

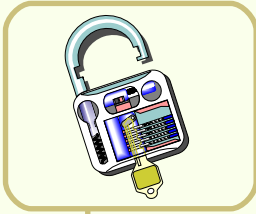
FIGURE 38—The General Motors *PASS* key has an electrical chip embedded in it. If the wrong key is inserted in the ignition, the car's computer disables.



Another common form of security is the car alarm. An electric, key-operated door lock is connected to a siren. When the owner locks the car door, the system turns on. If anyone else attempts to gain access to the car, the siren will go off. Some car alarms are so sensitive that they'll go off if someone bumps the car or taps a tool on a window, or if someone attempts to tamper with the hood of the car.

Remote control operates some newer-model car alarms. A receiver is simply mounted on the dashboard. To activate the alarm system, the owner closes the car door and presses the button on the remote control. Depending on the range of the remote control, the owner can turn the alarm on or off from a distance.

Before you proceed, please complete *Locking It Up! 2* on the following page.



Locking It Up! 2

Fill in the blanks in the following statements.

1. A _____ is a complete door opening set that includes a doorknob, a lock cylinder, a deadbolt, and all the hardware needed for installation.
2. A lock cylinder installed directly into the surface of a door is a _____.
3. A lock cylinder installed in a doorknob is a _____.
4. A _____ is a type of lockset used in hospitals or on doors designed to allow access to the disabled.
5. The three basic parts of a padlock are the _____, _____, and the _____.
6. The security system used on newer model General Motors vehicles is the _____.

Check your answers with those on page 57.

LOCKSMITHING SKILLS

Everyday Tasks

Professional locksmiths provide a variety of services for their customers. Let's take a look at some of these services now.

Duplicating Keys

Duplicating a key is to make one by copying another key that you use as a pattern. You duplicate most keys by machines that trace the original key to cut the same bitting in the new one. Duplicating produces a second key with the same shape.

Professional locksmiths also are able to duplicate a key manually, using a file.

Cutting Keys By Code

A way to duplicate keys when the original isn't available is to *cut them by code*. The code is a set of numbers (or letters) that helps the locksmith learn the correct combination for the key. There are books published for the locksmith industry and kept on hand for the locksmith that translate the code numbers. If the customer is able to supply the code number, the locksmith can make a new key almost as quickly as he or she could copy a key from the original.

Rekeying Locks

Rekeying is a procedure in which a locksmith changes the inside of a lock to fit a new key. This service is commonly requested when someone moves into a new home or when an employer dismisses a worker. Rekeying changes the lock so that the former owner or former employee can no longer use his or her key to gain entry.

Impressioning Keys

When a lock's key is lost, it's possible to make another key to fit by means of a procedure known as *impressioning*. In impressioning, you use the lock as a "mold" to make a new key. You impression a key by

- Inserting a blank key into the lock
- Turning the blank key against the interior of the lock
- Examining the marks made on the blank by the lock
- Using the marks as a guide to make cuts (the bitting)

Picking Locks

Lockpicking means opening a lock with the use of special tools rather than a key. A professional locksmith can pick a lock in three to five minutes on average, but it can take half an hour to open some locks. For some locks, the procedure requires two delicate instruments, one to put slight tension on the lock, and the other to manipulate tumblers. You can open simpler locks occasionally with a pair of stiff wires.

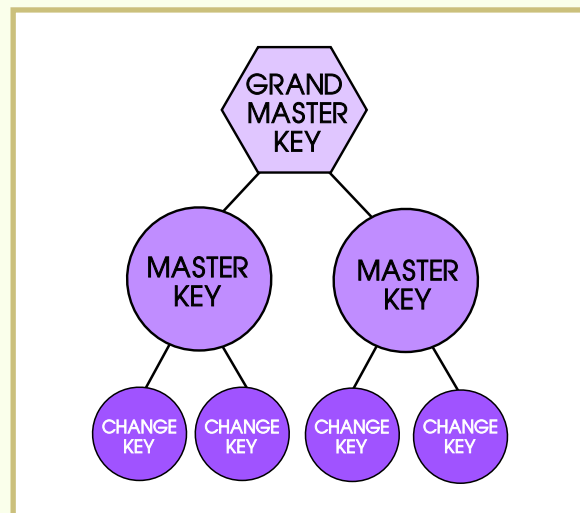
Reading Locks

Reading a lock is the art of visually examining the interior of a disk tumbler lock to see the placement of the tumblers. With the aid of a light, a locksmith peers into the key opening, or keyway, and notes the placement of the tumblers, “reading” them. The locksmith then cuts the key to fit that combination. This skill can be effective with locks having either disk tumblers or lever tumblers.

Master Keying

It often is desirable to set up a *master key system* in hotels, motels, large businesses, institutions—just about any place with a lot of doors. The locksmith can master key the locks for those who must have access to more than one room. For example, with a master key the custodian can enter and clean all the offices, while not permitting office employees to enter any other office than their own. Master key systems can be arranged in several levels, conforming to the levels of authority in an organization. The highest level of key will open all the locks in the system; the key of the lowest level will open only one (Figure 39). Locksmiths refer to the key that’s capable of opening only one lock as the *change key*. The levels each have a name, something like families: *change key*, *master key*, *grand master key*, *great grand master key*, and so on.

FIGURE 39—In a master key system, each change key will open only one lock. The master key will open all of them.



A Locksmith's Tools

Locksmiths use standard tools such as hammers, screwdrivers, and drills as well as specialized tools such as lock picks and key cutting machines.

As we mentioned, many of the tools found in a locksmith's shop are basic to many trades. If you're a "do-it-yourselfer," there's a good chance you already own many of them. The following list names some of the essential tools a locksmith always keeps handy.

- Assorted pliers
- Assorted screwdrivers
- Allen wrench set
- ½-inch electric drill
- Cordless electric drill
- Center punches
- Standard claw hammer
- Ball peen hammer
- Rubber mallet
- Ratchet wrench and sockets, both standard and metric
- Set of vise-grip pliers
- Bright flashlight
- Wood chisel (especially 1-inch size)
- C-clamps
- Pocket-size level
- Extension cord
- Electrical tape
- Miniflashlight or penlight

Specialized locksmithing tools include the following.

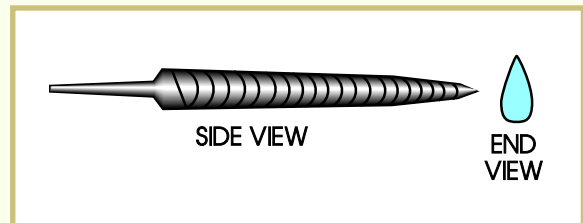
Bench vise. A bench vise (Figure 40) holds keys and cylinders firmly while you're working on them.

FIGURE 40—Bench Vise



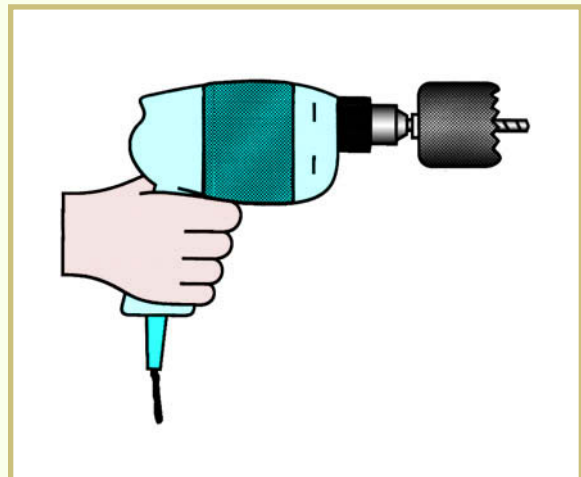
Assorted metal files. You use metal files in lock repair and for cutting keys by hand. Many locksmiths prefer and recommend the *pippin file* (Figure 41) for key duplication.

FIGURE 41—Pippin File



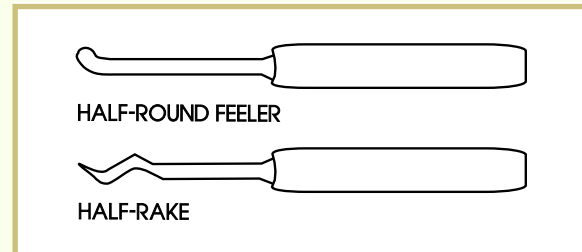
Hole saw kit. Locksmiths commonly use a hole saw kit for installing locksets in residential doors (Figure 42).

FIGURE 42—Use a drill, drill bits, and a hole saw for lock installations.



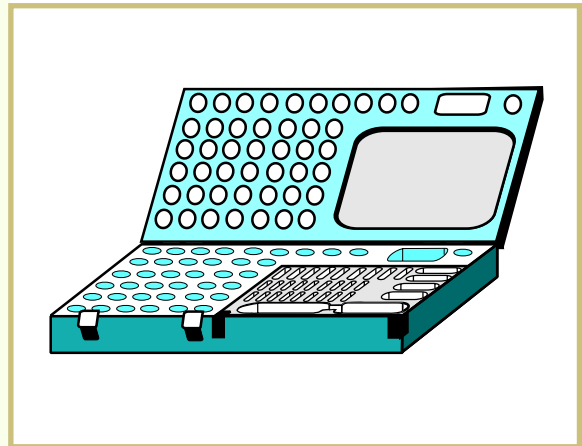
Lock pick. Lock picks of various shapes (Figure 43) open locks without a key.

FIGURE 43—Lock picks.



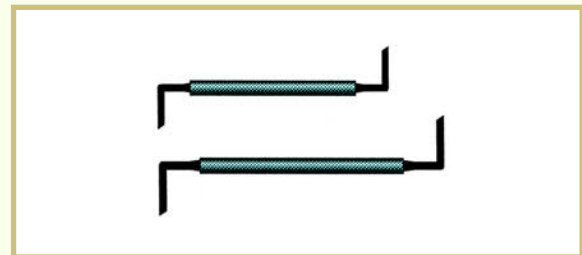
Pinning kit. You use pinning kits to rekey pin tumbler lock mechanisms. You may buy anything from a very small kit that's used with one lock type to a *universal pinning kit* (Figure 44) that's made to use with all locks.

FIGURE 44—Universal Pinning Kit



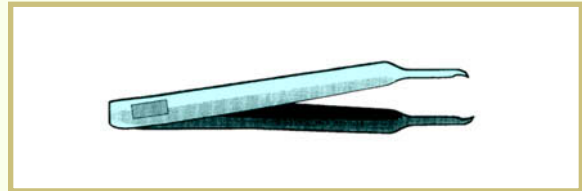
Tension wrench. You use a tension wrench (Figure 45) along with a lock pick when you pick a lock.

FIGURE 45—Tension Wrench



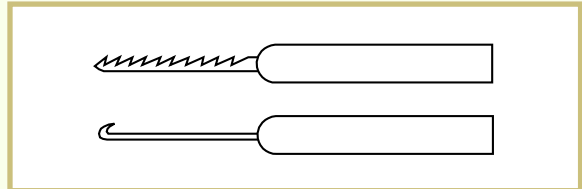
Formed-end tweezers. With formed-end tweezers (Figure 46), you can pick up small pins and springs when you're rekeying a lock.

FIGURE 46—Formed-end Tweezers



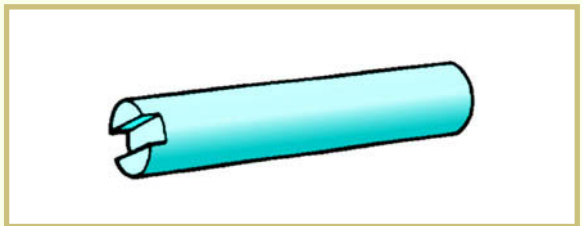
Broken key extractor. Using a broken key extractor, you can remove broken pieces of key from inside a lock (Figure 47).

FIGURE 47—Broken Key Extractor



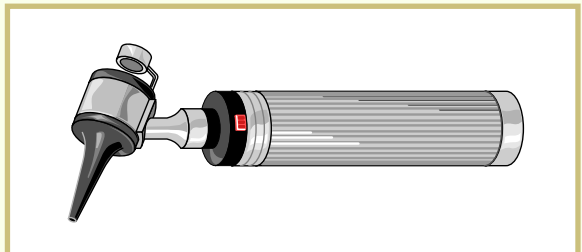
Plug follower. You use a plug follower when removing a plug from a lock cylinder. You insert the follower into the cylinder in place of the plug (Figure 48) to prevent the driver (top) pins and springs from falling out.

FIGURE 48—A Plug Follower



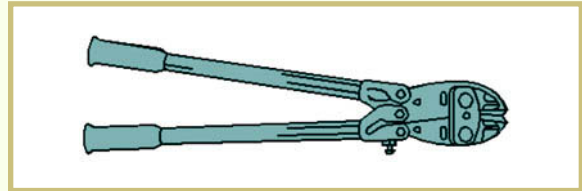
Otoscope. An otoscope is the instrument a doctor uses to shine light into people's ears and throats during an examination. A locksmith uses the same instrument to shine bright light into a small lock mechanism (Figure 49).

FIGURE 49—Otoscope



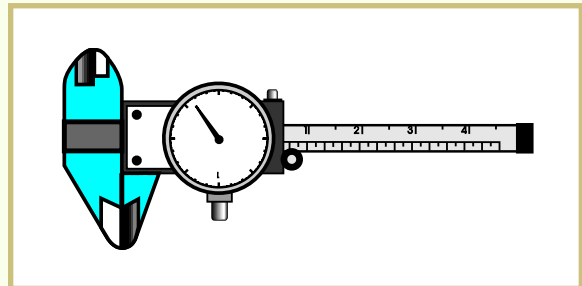
Bolt cutters. You can use a set of bolt cutters (Figure 50) to force open padlocks in an emergency.

FIGURE 50—Bolt Cutters



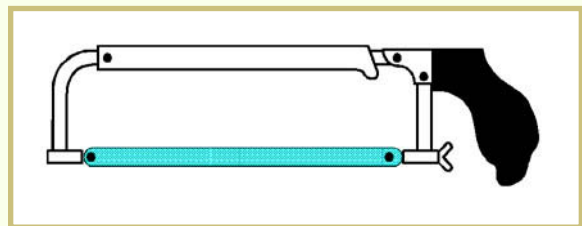
Dial caliper. A dial caliper (Figure 51) is useful for measuring pins, cuts in keys, and the dimensions of other lock parts.

FIGURE 51—Dial Caliper



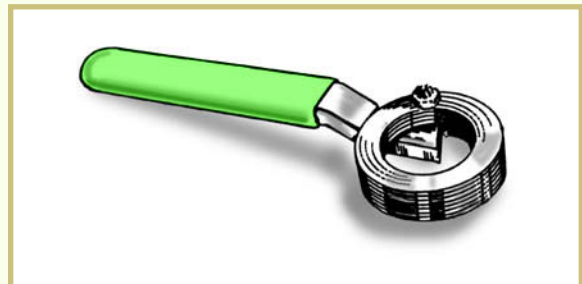
Hacksaw. A hacksaw (Figure 52) can cut through bolts in an emergency.

FIGURE 52—Hacksaw



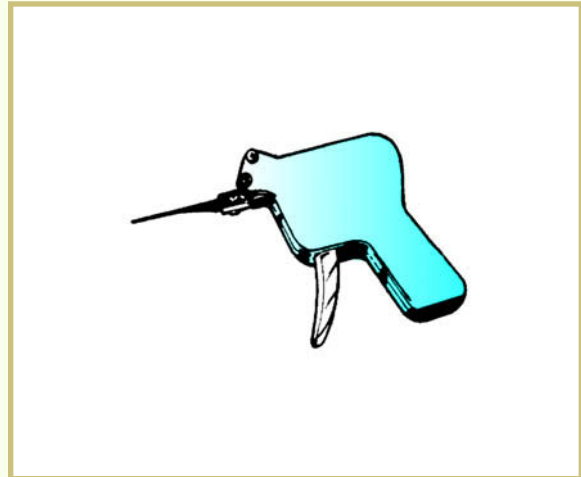
Cylinder removal tool. You would use a cylinder removal tool (Figure 53) to remove mortise cylinders from a door surface.

FIGURE 53—Cylinder Removal Tool



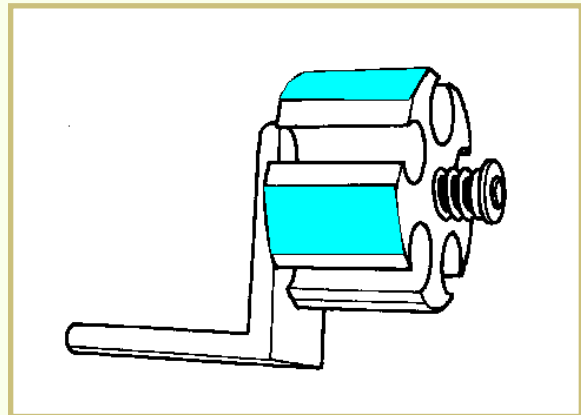
Picking gun. You can use a picking gun (Figure 54) to pick some kinds of locks quickly and easily.

FIGURE 54—Picking Gun



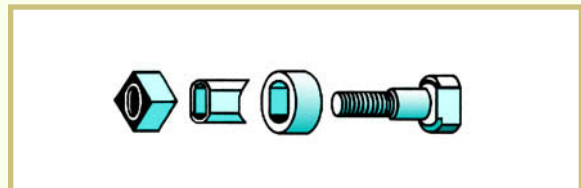
Plug holder. A plug holder (Figure 55) can be useful when rekeying or otherwise repairing lock cylinders and plugs.

FIGURE 55—Plug Holder



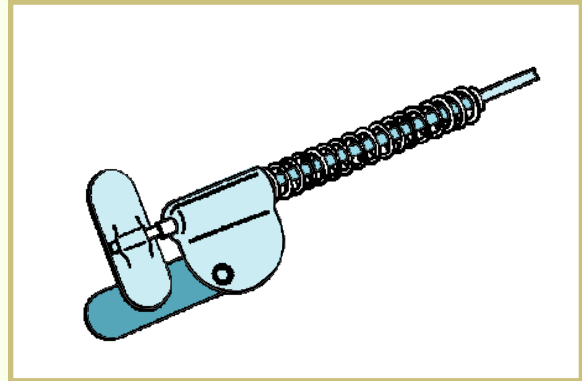
Double-D punch. A double-D punch (Figure 56) is useful for installing locks in metal cabinet doors and drawers.

FIGURE 56—Double-D Punch



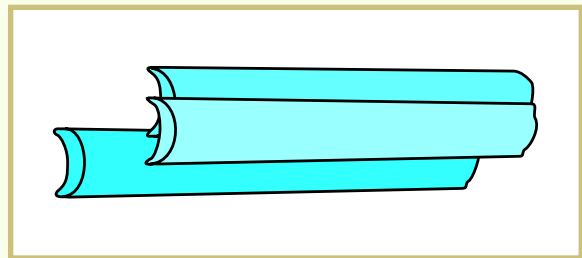
Plug spinner. Sometimes when a lock is being picked, the plug may accidentally turn in the wrong direction. A plug spinner (Figure 57) can rotate a plug in either direction to correct the situation.

FIGURE 57—Plug Spinner



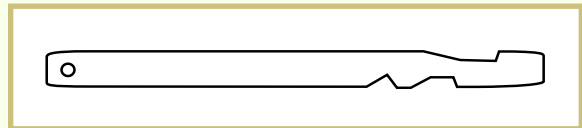
Shims. You may use thin metal shims (Figure 58) when taking pin tumbler cylinders apart.

FIGURE 58—Shims



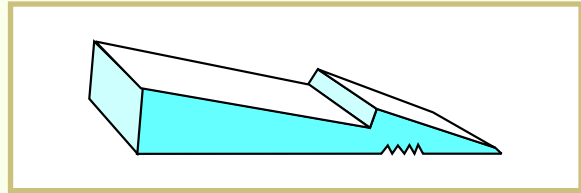
Car opening tools. You can use a wide variety of car opening tools to slide down into a car door mechanism and open a lock (Figure 59).

FIGURE 59—This figure shows the popular “Slim Jim” tool used to open car doors.



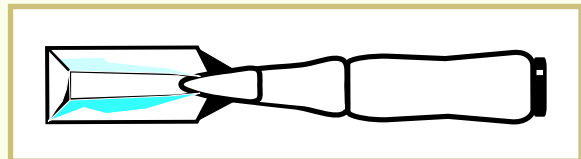
Car opening wedge. You can use a car opening wedge (Figure 60) in conjunction with car opening tools. When the fit of the car door’s window is too tight to allow you to slip in the car opening tool, you use the wedge between door and window to create a space for insertion. Take great care when forcing in the wedge to prevent the car’s window from shattering.

FIGURE 60—Car Opening Wedge



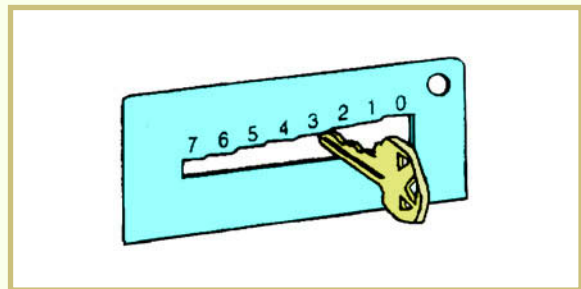
Wood chisel. When installing door locks in wooden doors, use a standard 1-inch-wide wood chisel (Figure 61).

FIGURE 61—Wood Chisel



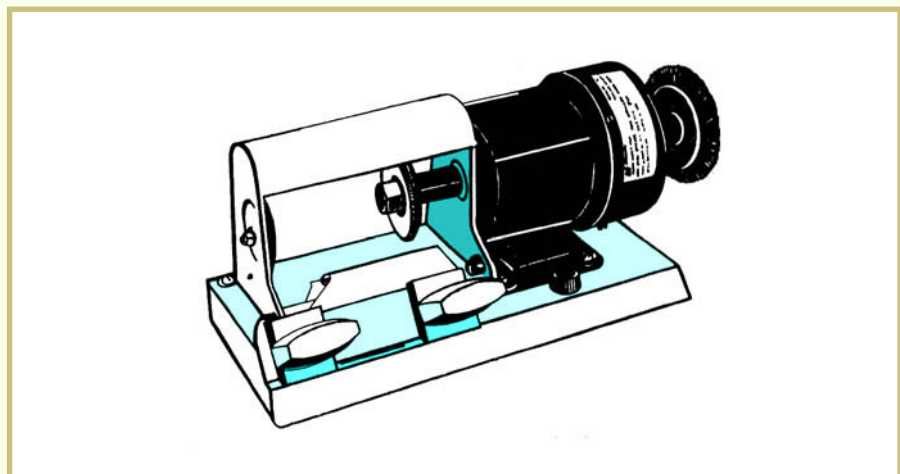
Key gage. A key gage (Figure 62) measures the depth of the cuts in a key.

FIGURE 62—Key Gage



Key duplicating machine. A key machine is standard equipment for the locksmith. A wide variety of machines is available to duplicate all kinds of keys (Figure 63).

FIGURE 63—This illustration shows a simple key machine used to duplicate cylinder keys.

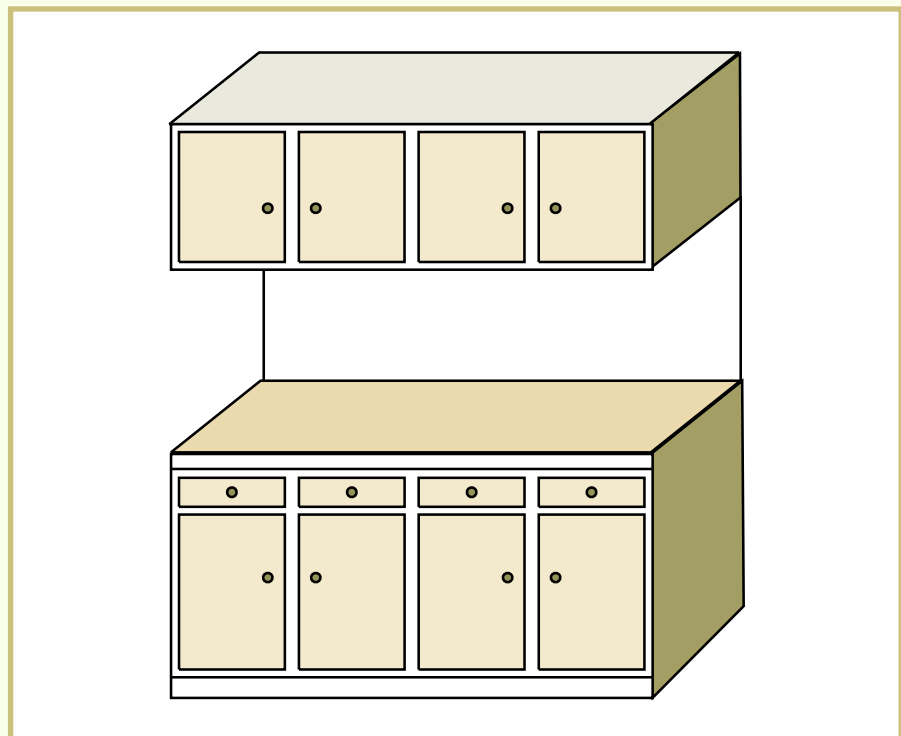


You can purchase many locksmithing tools individually or in sets. Sometimes, buying a complete set of tools is more practical and less expensive than buying tools one by one. However, a full set of tools can be a waste if you don't really need all the items in the set. Before you buy, try to determine what you really need and use most often.

However, all the tools that a professional locksmith uses should be well made and able to provide many years of service. Remember that a poor-quality tool can damage both you and the device you're working on. The small amount of money you save by buying an inferior tool you might pay out hundreds of times in botched jobs! Therefore, even though quality tools are sometimes more expensive, they're well worth the investment.

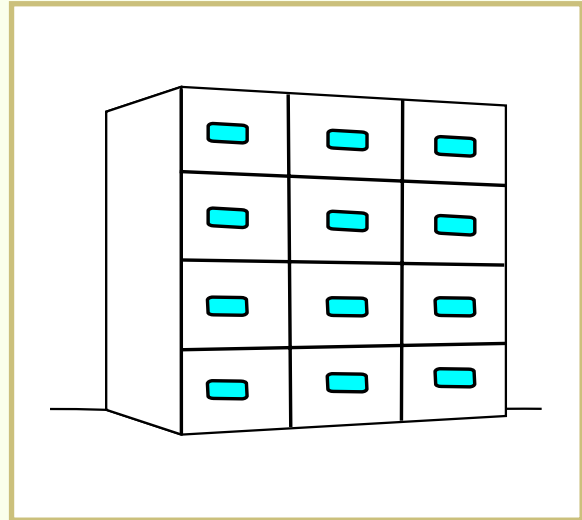
Professionals respect their tools and make sure they properly maintain and store them. Figure 64 shows a useful standing tool storage unit for locksmithing needs. When you purchase a tool storage unit, remember to allow room for future expansion. When your business grows, you may need more tools, and you'll already have the necessary space to store them.

FIGURE 64—A Standing Tool Storage Cabinet



You can also purchase smaller units or organizers for use on top of your worktable (Figure 65). Or, make some useful

FIGURE 65—Pictured here is a small organizer with drawers for the top of your worktable.



organizers for yourself out of discarded cigar boxes, egg cartons, or shoe boxes.

The next section of the text contains your first hands-on practice exercise. In this exercise, you'll examine the function of your cutaway padlock. You'll find the padlock in your first shipment of study materials.

Now, before you proceed to the practice exercise, take a few moments to complete *Locking It Up! 3*.



Locking It Up! 3

Indicate whether each of the following statements is True or False.

- _____ 1. In impressioning, you alter the interior mechanism of a lock to fit a new key.
- _____ 2. In rekeying, you use a key cutting machine to duplicate keys.
- _____ 3. Many locksmiths prefer the pippin file for filing keys by hand.
- _____ 4. You would use lock picks to rekey a pin tumbler lock.
- _____ 5. In a master key system, a master key would open all change key locks.

Check your answers with those on page 57.

PRACTICE EXERCISE

Introduction

This practice exercise covers the operation of a pin tumbler lock mechanism. As we mentioned earlier in this study unit, the pin tumbler lock mechanism has existed since Egyptian times. The early Egyptian lock used pins that, like today's locks, raised the pins. When the pins were raised, a sliding bolt released to open the door. The key used for these locks was a small wood device that looked like a toothbrush fitted with wooden pegs.

Today's pin tumbler locks work on the same basic principle of raising pins to open the lock. Refinements in the manufacturing process have made today's pin tumbler lock a precision device.

Your Cutaway Padlock

The cutaway padlock that comes with your course is a high-quality locking device containing a pin tumbler mechanism. Let's take a look at how your lock works.

Remove your lock from its box. The manufacturer prepared the shell of this lock to allow you to see the internal working parts of the lock. Look carefully at the lock and note that it has four major parts: the shell, the shackle, the locking mechanism, and the plug (Figure A).

The lock consists of two types of metal. The shackle is hardened steel. The remainder of the lock (except the springs) is a brass alloy, which prevents the lock from rusting if it's used outdoors.

The locking mechanism near the top of the lock holds the shackle in two locations. The two *tangs* at the top of the plug, when rotated, cause the locking mechanism to retract (Figure B). This action causes the shackle to rise under spring pressure. Place the key in the lock and turn it very slowly. Watch the tangs and how they place pressure on the lock mechanism.

FIGURE A—Shown here are the four main parts of the cutaway padlock.

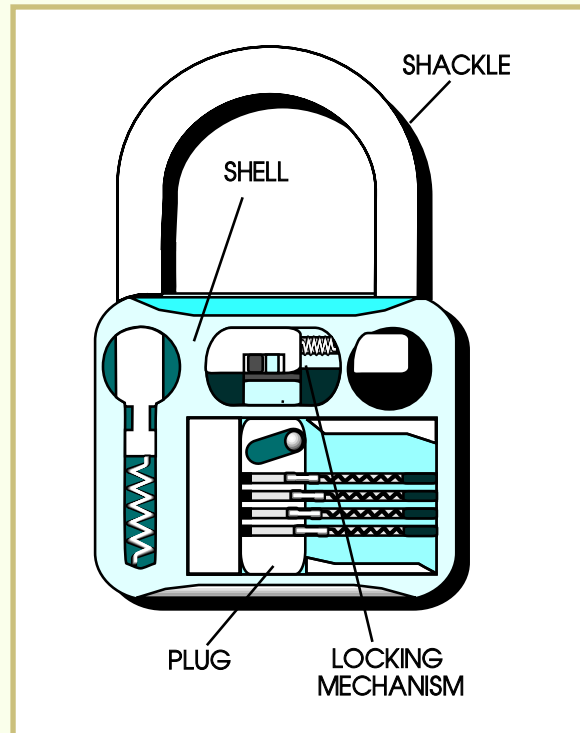
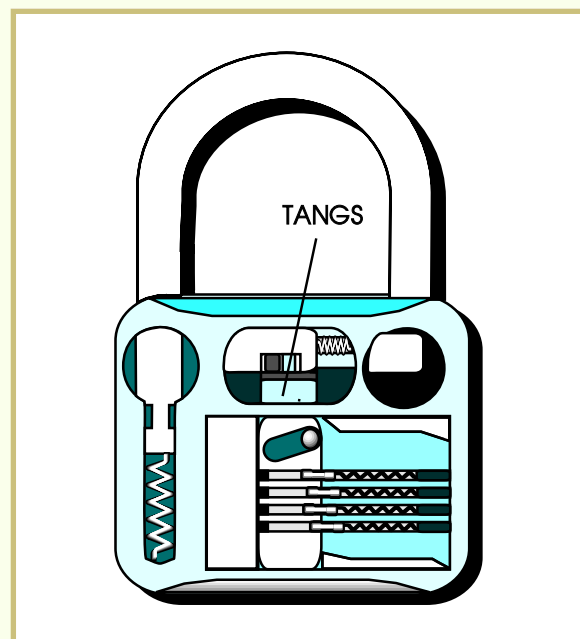


FIGURE B—When the lock plug rotates, the tangs place pressure on the locking mechanism and force it to retract.



The final components of the lock are the *plug* and the *pins* (Figure C). The plug contains the keyway (the slot the key is inserted into) and also holds the bottom pins.

The *top pins* are held in between the plug and the shell, preventing the plug from rotating. All of the pins are pushed downward into the plug by springs in the shell (Figure D).

FIGURE C—This illustration shows the parts of the lock's plug.

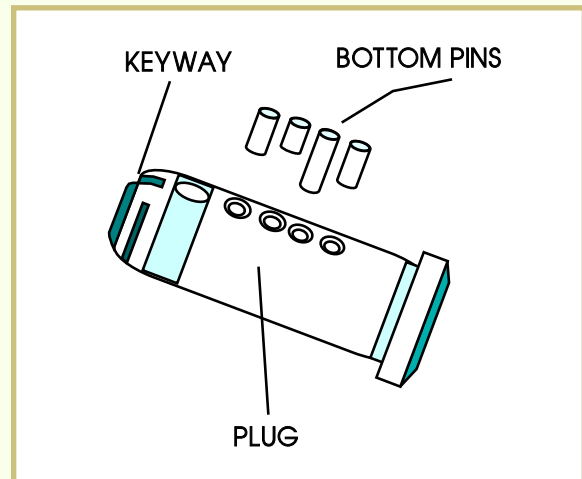
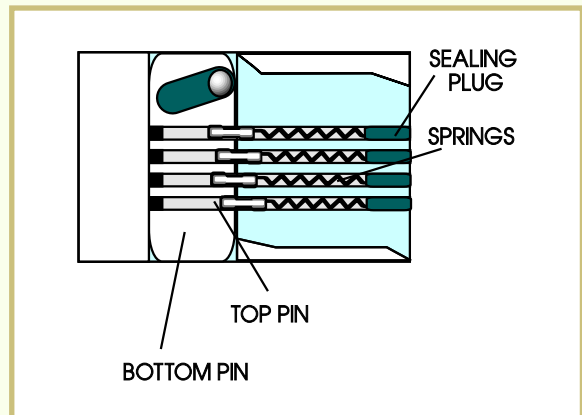
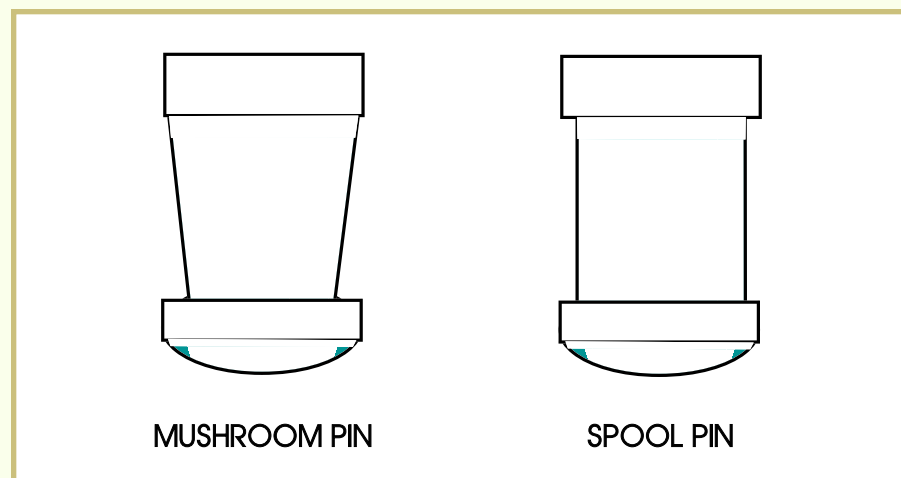


FIGURE D—This illustration shows a close-up of the pin assembly in your padlock.



Notice the shape of the top and bottom pins. The top pins are shaped like a spool or a mushroom (Figure E), and the bottom pins are shaped like a cylinder. The shape of the pins can prevent successful picking attempts, and so we call them *pick-resistant pins*.

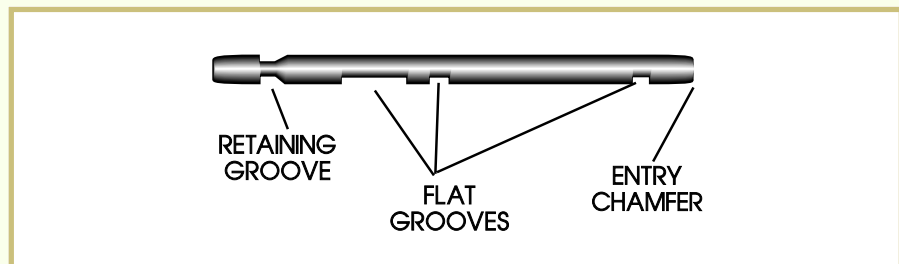
FIGURE E—Here are two types of pick-resistant top pins used in some types of pin tumbler locks.



How Your Lock Was Manufactured

Now, let's look at how this lock was made, starting with the shackle. The shackle begins as a piece of round steel stock. The steel stock is placed in a lathe where the *entry chamfer* and the *retaining groove* are cut. The stock is then cut to the proper length. Next, the shackle is placed in a milling machine where the flat grooves are cut. The shackle is then bent in a forming machine, hardened in an oven, and finally plated with high-gloss metal. Figure F shows the cuts made in the shackle before it's bent.

FIGURE F—Shown here is how the padlock shackle would appear after it's machined and before it's bent.



The lock's shell has a number of machining operations performed on it. The solid brass block is first shaped and squared on all four edges. Then, the two shackle holes are drilled in the block. Note that one hole is much deeper than the other hole. If you open your padlock and look at the bottom of each shackle hole, you can see where the end of the drill bit left cone-shaped depressions. The same drill bit then bores a hole through the side of the case for the locking mechanism.

A larger-diameter drill bit is used to drill the plug hole. Since the plug hole ends at the locking mechanism's hole, we can't see the cone-shaped depression at the top of the lock.

A very small drill bit is then used to drill the final holes. Four holes are drilled for the pin chambers through the side of the lock. Two additional holes are drilled for two brass retaining pins that will hold the plug and the shackle inside the lock.

Various other metalworking processes went into the manufacture of your lock. Holes were bored and slots cut away so that you would be able to see the inner workings of the lock. However, since these holes have nothing to do with how the lock works, we won't discuss them further here.

How Your Lock Was Assembled

The first step in assembling a padlock is the insertion of the shackle spring and shackle. Once these two components are installed, a brass pin is pressed into the shell to hold the shackle in the shell. The locking mechanism is then inserted through the hole in the side of the shell. With the shackle still open, the empty plug is inserted into the shell and the locking mechanism is aligned with the rear tangs of the plug.

Once the plug's tangs are aligned into the locking mechanism, a second brass pin is pressed into the shell to hold the plug in place. This pin is installed on the opposite side of the shell from the shackle retaining pin.

The bottom pins, top pins, and springs are then inserted into the pin chambers through the side of the lock. The lock's combination is determined before the process begins. In this way, the manufacturer can install the exact size pins necessary to create the proper combination.

Many lock manufacturers stamp a code number on the shell of the lock. The code number refers to the exact pin combination of the lock. The manufacturer then records the code number and the pin sizes it corresponds to in a code book. If a key is lost, a locksmith looking in the code book can cut a new key from these code numbers.

The final process in creating your pin tumbler lock is to plug the holes that lead to the locking mechanism and the four pin chambers. High pressure is used to push brass sealing plugs into each hole in the shell. All surfaces of the lock are then sanded smooth and finished. The surface sanding and polishing make it very difficult to see where the plugs were put in.

If you rotate your lock under a bright light, you can see the location of the sealing plugs on the outside of the shell. You'll find this same type of construction on many types of padlocks.

Besides the obvious holes and slots cut into your lock, your padlock differs in one major way from a standard padlock. In your lock, the plug is slotted or grooved to allow you to see the bottom pins. In a standard pin tumbler lock, the plug is drilled with holes and no slots are provided.

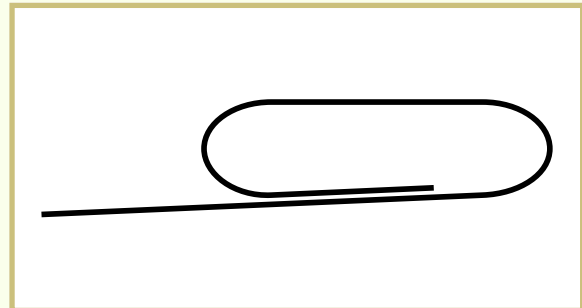
Exercise Instructions

Now, get ready to complete your first hands-on exercise with your cutaway padlock. In this exercise, you'll be using an ordinary paper clip or piece of stiff wire to lift the pins inside the lock. This will show you how the pins move inside the lock and how they must be aligned to free the locking mechanism.

Your lock is strong and should last a long time, even though it has had large amounts of metal cut away from the front. However, the lock is a delicate and precisely manufactured instrument. Be careful when working with the lock. Don't force it! If your lock binds, apply a little graphite powder or Tri-Flow to the locking mechanism, plug, and pins to free the lock. Also, *DO NOT* attempt to disassemble this lock. You'll need it for exercises in later study units.

Step 1: Take a small paper clip (or a piece of stiff wire) and bend it open as shown in Figure G. This will be our tool for exploring the inner workings of the lock.

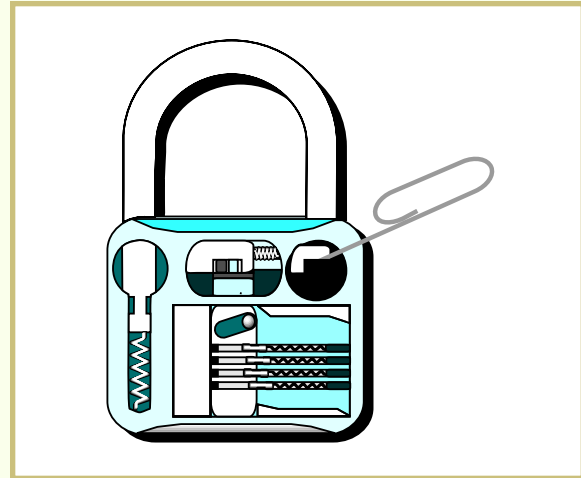
FIGURE G—Bend a paper clip as shown here to use in manipulating the internal components of the lock.



Step 2: Remove the key, if present, from the lock.

Step 3: Hold the lock sideways in your hand. Use the paper clip to push inward on the locking mechanism's catches or pawls as shown in Figure H. You may notice that when pushing in on one pawl, the shackle will move slightly upward, holding the pawl out of the shackle groove. Then, if you press inward on the second pawl, the shackle will open. Notice how hard it was to move the locking mechanism? The locking mechanism securely holds the shackle into the lock's shell until the plug is turned. It would be very difficult to open the lock by hitting it on each side with a hammer or other object.

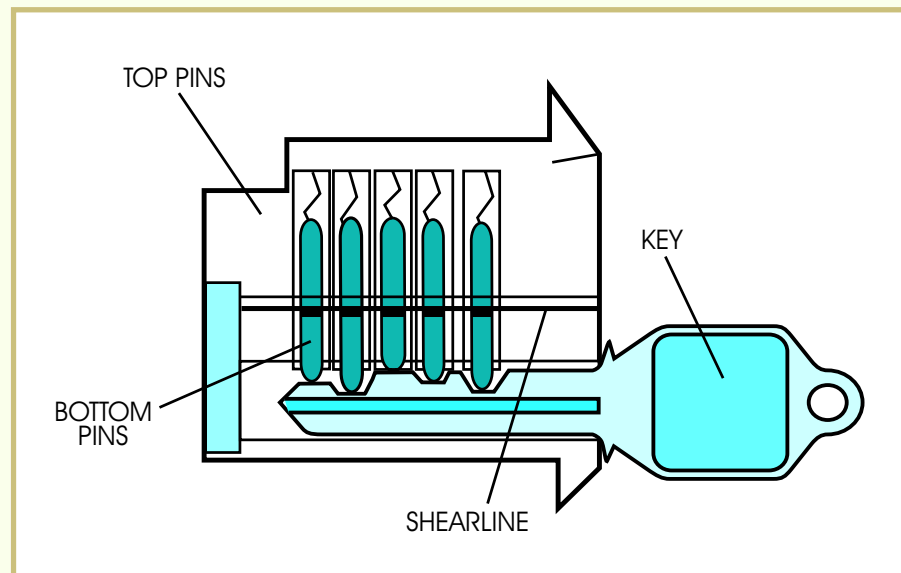
FIGURE H—You can force the locking mechanism backward to see how much force is placed on the shackle by this mechanism.



Step 4: Use the straight side of the paper clip to lift all of the pins inside the cylinder. Place the paper clip in the plug, just as you would the key. Move the paper clip upward to move the pins. Note how the top pins are all of the same height. The bottom pins, however, are of different heights. These are the pins that set the combination of the lock.

Step 5: Now, remove the paper clip and insert the key. Note how the tops of the bottom pins and the bottoms of the top pins all line up at the *shearline* of the plug as shown in Figure I.

FIGURE I—When the key is installed into your lock, the cuts in the key will raise the top pins above the shearline in all five pin chambers. The bottom pins will align themselves exactly at the shearline.



Conclusion

The following are some important facts to remember from the exercise.

- Your lock contains a double-sided locking mechanism that holds the shackle securely at both the heel and toe of the lock.
- Brass pins hold the shackle and plug in the lock.
- Small plugs hide the holes that are placed in the lock during manufacture.
- When the pins line up at the shearline of the plug, the plug of the pin tumbler lock can rotate.
- The key blade contains cuts that lift the bottom pins the exact amount needed to lift the top pins out of the plug and above the shearline.

Practice Exercise Questions

Now, let's see how well you know your pin tumbler lock. Check your understanding of this exercise by answering the following questions. Writing the answers to these questions will help you review what you've studied so far. *Do not* send the answers to this exercise back to the school for grading.

1. Why is the shell of your lock made of brass?

2. Which one of the springs is the largest spring on the lock?

3. If you take your paper clip and use the back end to try to turn the plug, why won't it turn?

4. What is the purpose of the spring in the locking mechanism?

5. What type of pick-resistant top pins are used on your lock?

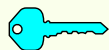
Check your answers with those on page 59.

THE KEY TO SUCCESS

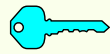
Well, you've come to the end of another information-packed study unit. Think about all you've learned so far! You now know about the major lock mechanisms and how they work, how we use locks for everyday security, and the different types of locks you'll likely see in your professional work. You've completed a valuable hands-on exercise with your cutaway padlock. You also learned about the typical jobs locksmiths do and the tools they use. Before you know it, you'll be using these same tools every day in your career as a locksmith!

Now, when you're ready, read through the following section of the text, *Key Points to Remember*. This is a review section designed to highlight all the most important facts you learned in this study unit. When you've reviewed the material and feel you know it well, proceed to the examination. Good luck!

KEY POINTS TO REMEMBER

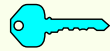


A modern locksmith may service many different types of locks. For this reason, locksmiths try to become familiar with all kinds of security products.

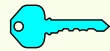


A key-operated lock is any type of lock that you open with a key. A key-operated door lock has three main parts.

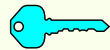
- A plug and the cylinder that surrounds it
- A latch or bolt
- A key



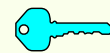
The plug is the tube containing the small parts that operate the bolt or latch. The cylinder is the tube assembly that surrounds and holds the plug. The key is the device that opens the lock.



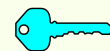
A key-operated door lock may have a latch, a bolt, or both. Both latches and bolts protrude out of the lock and fit into a recessed space in the door frame called a strike. The end of a latch is cut at an angle, while the bolt has a squared-off end. A bolt is thrown into the strike by turning a thumbpiece by hand or by using the key.



There are four common mechanisms used inside modern key-operated locks. The warded mechanism is the oldest type of lock still in use today. The interior of the lock has protruding ridges called wards that prevent the wrong key from being inserted to throw the bolt. Lever tumbler locks have flat metal plates that slide into place as the correct key is turned, allowing the lock to open. The disk tumbler lock mechanism contains rectangular metal disks that can move up and down. Pin tumbler locks contain small metal pins aligned in a row along the length of the cylinder.



Padlocks have three basic parts: the (1) key, the (2) casing, and the (3) shackle. The casing is simply the outer shell of the padlock. The shackle is a U-shaped piece of hardened steel that extends out of the main body of the padlock. The padlock locks when the shackle is secured inside the lock.

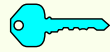


There are four basic key types. The bit key is used with warded locks. The barrel key is a variation of the bit key. The tubular key is a modern variation of the barrel key that's used with vending machines and computers. Lever keys are commonly used for lever locks. The cylinder key is used with disk and pin tumbler locks.

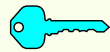


Three parts are common to most types of keys. The bow is the handle of a key. The shoulder is wider than the blade and

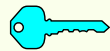
prevents the key from being pushed too far into a lock. The biting is the pattern of notches cut into the edge of the key.



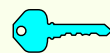
A lockset is any complete door opening set that includes a doorknob, a lock cylinder, a deadbolt, and all the hardware needed for installation. Most modern locksets contain pin tumbler cylinders. The cylinder may be installed directly into the surface of a door (a mortise cylinder), or in a doorknob (a key-in-knob lock). An entrance handleset is a special type of lockset in which you grasp the handle and press down the thumbpiece to open the door. You'll find the lever lock in hospitals or on doors designed to allow access to the disabled. The shape of the lever handle makes it easier to grasp than a standard doorknob.



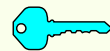
Locksmiths occasionally describe door locks by the way they're installed. For example, a door lock that fits into a recessed area cut into a door is a mortise lock. A rim lock is a type of door lock installed on the surface or rim of a door. A cylindrical lock is a lock that's shaped like a cylinder and fits into a tunnel cut into the door.



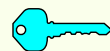
An auxiliary lock is simply an "extra" lock installed on a door to provide backup security. Common key-operated auxiliary locks are the tubular deadbolt and the turn knob rim lock.



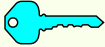
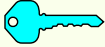
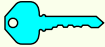
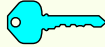
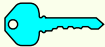
The term *specialty lock* applies to a variety of locking devices used for specific security purposes. Some common specialty locks are padlocks, gun locks, luggage locks, bicycle locks, trailer locks (used to lock a trailer hookup on a vehicle), cable locks, vending machine locks, and ski locks.



Office locks include a variety of devices used to secure equipment and documents in office buildings. You'll find the cam lock used most often used in desk drawers and cabinets. A file cabinet bar locks in place over the fronts of file drawers, preventing them from pulling out. A computer lock prevents the computer's keyboard from operating.



A combination lock is a lock that you open by dialing a series of numbers instead of inserting a key. Many padlocks and safes use combination locks. A time lock is used in conjunction with a combination lock to allow the door to open at a certain time of day. A push-button combination lock requires the user to press one or more buttons in a sequence to open the lock.

-  You'll find a variety of safes of all sizes in homes, businesses, and banks. Models are available that install in floors, walls, or under counters. In addition, specialty safes are designed to store and protect rifles, pistols, and paper documents.
-  You'll find electrically operated locks and release latches used on the doors of large office and industrial buildings. A code number punched into a key pad or a swipe with a card key opens the locks. The card key has a coded magnetic strip that actuates the lock. The card has a magnetized strip that actuates the lock.
-  There are two basic types of electronic alarm systems: (1) local and (2) central. A local alarm sounds only at the building where it's installed. Central alarms are connected to a monitor station owned and operated by a private alarm company.
-  In addition to electronic alarms, a number of security devices protect homes and businesses. Some of these include foil, pressure mats, vibration detectors, photoelectric beams, and panic buttons.
-  Professional locksmiths provide a variety of services for their customers, including key duplication, rekeying, impressioning, lockpicking, reading, and masterkeying. They use both standard tools (hammers, screwdrivers, and drills) and specialized locksmithing tools (lock picks and key cutting machines) to perform these tasks. All the tools that professional locksmiths use should be well-made and able to provide many years of service.

NOTES

Locking It Up! Answers

1

1. key-operated
2. cylinder
3. double-cylinder
4. bit keys, barrel keys, flat keys, cylinder keys, and dimple keys
5. bow
6. bitting
7. bolt
8. warded, disk tumbler, lever tumble, pin tumbler
9. warded

2

1. lockset
2. mortise cylinder
3. key-in-knob lock
4. lever handle lock
5. shackle, casing, key
6. PASS system (Personal Antitheft Security System)

3

1. False. In impressioning, the lock is used as a mold to make a new key.
2. False. Rekeying is when you change the inside of a lock to fit a new key.
3. True
4. False. You use lock picks to open locks without a key.
5. True

NOTES

Practice Exercise Answers

1. The shell is made of brass to prevent rusting in outdoor applications.
2. The spring beneath the long end of the shackle is the largest spring.
3. The plug won't turn because the top pins block the rotation of the plug.
4. The spring in the locking mechanism holds the locking pawls firmly in the grooves of the shackle.
5. Your lock uses pick-resistant, spool-shaped top pins.

NOTES

Introduction to Locks and Keys

EXAMINATION NUMBER:

03100202

Whichever method you use in submitting your exam answers to the school, you must use the number above.

**For the quickest test results, go to
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When you feel confident that you have mastered the material in Lesson 6, go to <http://www.takeexamonline.com> and submit your answers online. If you don't have access to the Internet, you can phone in or mail in your exam. Submit your answers for this examination as soon as you complete it. *Do not wait until another examination is ready.*

Questions 1–20: Select the one best answer to each question.

1. All of the following are part of a padlock except which one?

- | | |
|------------------|-------------------|
| A. Casing | C. Key |
| B. Latch | D. Shackle |

2. Which of the following lock types are most frequently used in cars?

- | | |
|------------------------------------|--|
| A. Disk tumbler and warded | C. Pin tumbler and disk tumbler |
| B. Warded and lever tumbler | D. Lever tumbler and disk tumbler |

3. A double-cylinder lock is a good choice for when you want the ability to lock a door

- A.** without using a key.
- B.** with the same key used for the car's ignition.
- C.** from outside the building as well as from the inside.
- D.** in two different spots along the door's frame.

4. The process of changing the internal mechanism of a lock to fit a new key is called
- A. impressioning.
 - B. rekeying.
 - C. duplicating.
 - D. lockpicking.
5. Which of the following best describes a *strike*?
- A. A tool used to saw holes in a door
 - B. The motion used to cut notches in a key blank
 - C. The recessed space in a door frame that accepts the bolt or latch
 - D. The numbered dial on the front of a combination lock
6. The process of using a lock as a “mold” to make a new key is called
- A. rekeying.
 - B. lockpicking.
 - C. impressioning.
 - D. reading.
7. Which of the following keys is a type of bit key?
- A. Cylinder key
 - B. Barrel key
 - C. Lever key
 - D. Disk key
8. What are the main parts of a combination padlock’s inner mechanism?
- A. The wheels or tumblers
 - B. The shackles
 - C. The keys
 - D. The barrels
9. The oldest known lock in existence was discovered in Egypt. What basic type of mechanism does this ancient lock contain?
- A. Pin tumbler
 - B. Lever tumbler
 - C. Warded
 - D. Disk tumbler
10. Which of the following best describes the purpose of a *time lock*?
- A. It allows a safe to be opened at a certain time of the day.
 - B. It’s used to secure time clocks in the workplace.
 - C. It’s opened with a coded plastic card.
 - D. It’s fitted with a panic button in case of a sudden robbery.
11. What type of key is most commonly used in door locks and car ignitions today?
- A. Cylinder key
 - B. Bit key
 - C. Barrel key
 - D. Flat key
12. Any complete door opening set that includes a doorknob, a lock cylinder, a deadbolt, and all the hardware needed for installation is called a
- A. mortise cylinder.
 - B. rim cylinder.
 - C. door stile.
 - D. lockset.

13. Which of the following key parts is present in *all* types of keys?
- A. Bow
 - B. Shoulder
 - C. Barrel
 - D. Blade
14. The cylinder of a lock is the
- A. opening where the key fits through.
 - B. tunnel that a key slides into.
 - C. recess in the door frame that accepts the bolt.
 - D. tube surrounding the plug.
15. A lock cylinder that can be installed directly into the surface of a door is called a
- A. strike.
 - B. mortise cylinder.
 - C. padlock.
 - D. rim cylinder.
16. What shape does the end of a deadbolt have?
- A. Angled
 - B. Pointed
 - C. Squared
 - D. Rounded
17. What type of key is used with the locks most often found on vending machines and computers?
- A. Flat key
 - B. Bit key
 - C. Tubular key
 - D. Cylinder key
18. Hotels, motels, large businesses, and institutions frequently use what type of key system?
- A. A tubular key system
 - B. A precut key system
 - C. A blank key system
 - D. A master key system
19. The Yale lock is also known as the
- A. card key lock.
 - B. pin-rim deadlock.
 - C. computer lock.
 - D. pin cylinder lock.
20. Which of the following describes a key's *bow*?
- A. The overall shape of a key
 - B. The notches on the side of a key
 - C. The tip of a key
 - D. The handle of a key