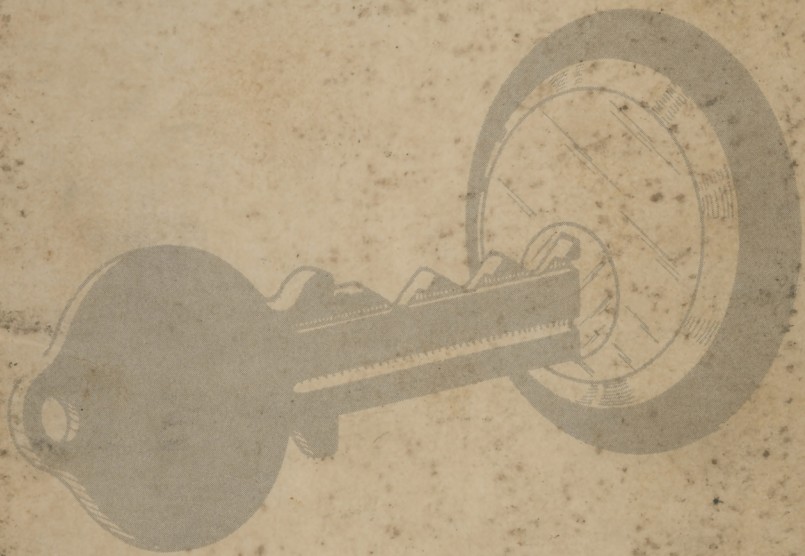
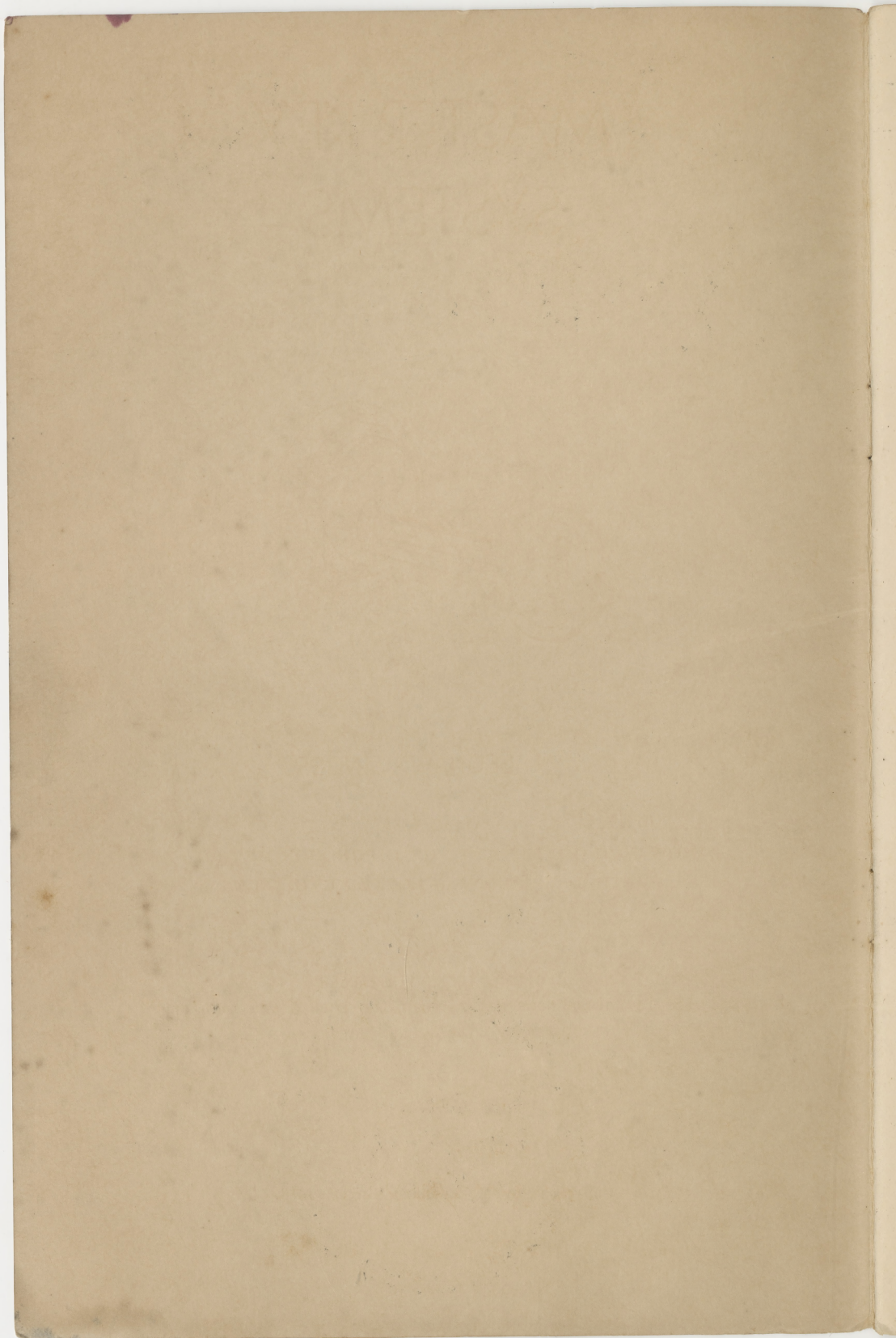


Master Key Systems

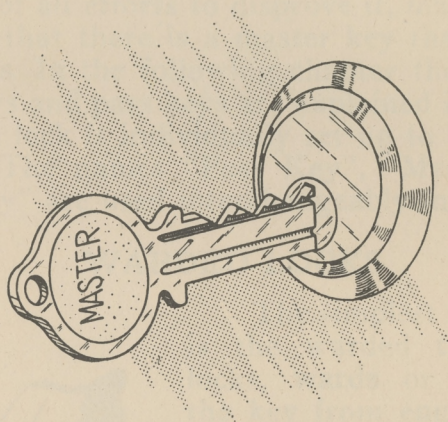


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MASTER KEY SYSTEMS



BY M. LEONARD SINGER

Author of

HOW TO MAKE KEYS BY THE IMPRESSION METHOD
METHODS OF GAINING LOCKED EVIDENCE

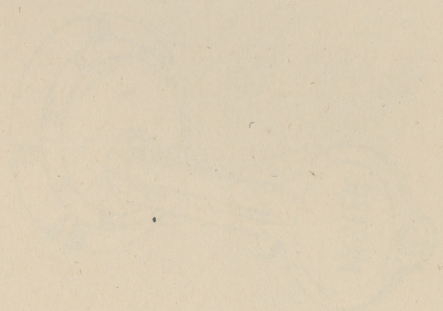
Editor, LOCKSMITH LEDGER

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MASTER KEY

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MASTER KEY SYSTEMS

Whenever a large group of locks is used, it is convenient to use a master key instead of carrying a duplicate key for each lock. The mechanical principles involved in master key set-ups are simple to understand once they are explained, but the legends and fancies that have grown up about a master key have caused confusion and misunderstanding.

In spite of all efforts to disprove it, many people foolishly believe that there is a master key that will open all types of locks. In the following chapter the various types of master keys and pass keys are explained in detail, showing how each lock is **individually** set up to be operated by such a key. The names "Pass Key", "Master Key" and "Skeleton Key" are used interchangeably in this book.

WARDED LOCKS

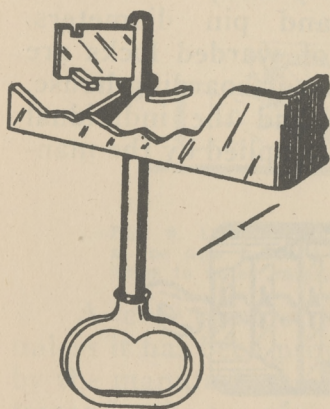


Fig. 1 The key turns because the bit has been notched to pass the ward.

The simplest lock, of course, is the warded type. In these locks, **wards** or **stops** prevent the key from engaging the mechanism. In the illustration, Figure 1, the bit key turns because the key is filed to by-pass the ward. Since the manufacturer may place a ward in any position, he can make a series of locks that cannot be opened except by the key that has its ward cuts correspond with the position of the wards in the lock. Thus the manufacturer obtains

what is known as **key changes**. The better the lock, the more key changes are used.

A master key, or pass key for this type of lock is one that will by-pass all of the wards. In the illustration, Figure 2, it can be seen that the wide ward cuts of the master key allow it to by-pass any of the wards that are found in the individual locks.

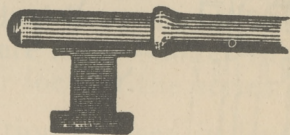


Fig. 2 The wide notches on the sides of the bit enable this key to pass the wards of all locks of this type.

To increase the security of these locks, the manufacturers also employ keyway wards. Figure 3. In this manner,

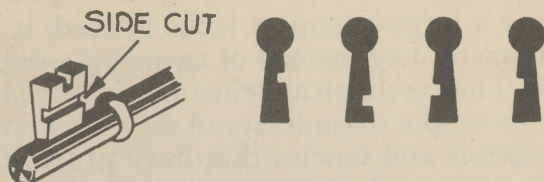


Fig. 3. The groove along the side of the regular key must correspond to the keyway wards. A pass key bit is thin enough to enter the keyway without being stopped by the wards.

the keys without the correctly located side grooves cannot enter the keyway. However, the bit of the pass key is thin enough to by-pass these keyway wards also.

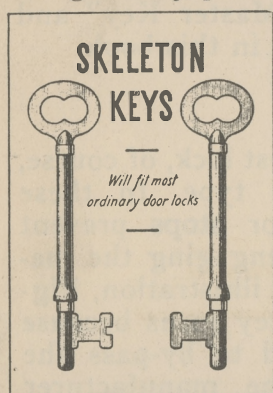


Fig. 4 Commercial "Skeleton" or Pass Keys.

In Figure 4 typical pass keys for bit key locks are pictured. These are frequently referred to as "Skeleton Keys". They may be purchased in various sizes and pin diameters. When a series of warded locks are used in a rooming or boarding house, the master key and the individual change keys are supplied by the manufacturer.

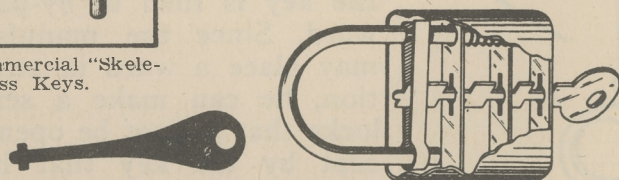


Fig. 5. Inside view of warded padlock with regular key inserted and type of pass key used to open these locks.

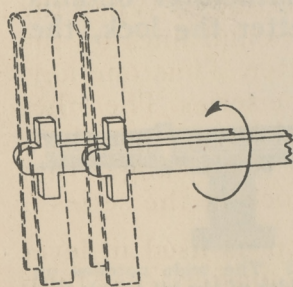


Fig. 6. Adjustable double "T" pass key.

Warded padlocks also can be opened by master or pass keys using the same principle that applies to warded bit key locks. Since padlock keys are usually **double bitted** (double sided) the pass key appears as shown in Figure 5.

In some types of warded locks, there are double horseshoe springs that lock the shackle; therefore a double "T" type of pass key is

necessary. An adjustable pass key is made by placing two thin "T" keys together and sliding them in the lock until both of the springs are located and spread open. Figure 6.



Fig. 7. Barrel type key, showing cross section view of bit.

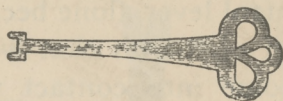


Fig. 8. Pass key to open inexpensive door latches.

Cabinet and drawer locks using the barrel type of key shown in Figure 7 are warded locks. The key that fits one lock will fit all others of the same type. Different key changes are not used in these locks.

Several inexpensive warded door latches are operated by the type of pass key shown in figure 8.

LEVER LOCKS

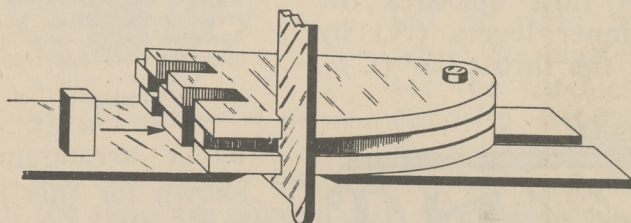


Fig. 9. Double gate levers being operated by master key. notice how forward set of gates are in alignment to allow fence to enter gates.

A lever tumbler lock does not open with a master key unless it has been provided with a master key arrangement by the manufacturer. The simplest master key set up is obtained by the use of double gated levers. Figure 9. In a mastered lock the additional set of gates is arranged in a combination that is duplicated in all the other locks. When the master key is inserted, it raises the levers and lines up the master gates, permitting the fence to enter. Thus one key, the master, can operate all the locks in the series. The other set of gates is reserved for the individual keys, since these gates vary in position in all locks, there is no danger that the individual key will open any other lock in the series.

Another type of master construction as used in lever locks is the control lever. In this type, a master lever tumbler has a pin extending through it. Figure 10. This pin

rides in the oval slots of the regular levers. When the master key is turned, it operates the control lever alone because the part of the bit that would have come into contact with the regular tumblers has been removed. The control lever pin raises the other levers as indicated in the illustration and thus brings them into alignment with the bolt fence.

A variation of the control lever type is shown in Figure 11. Here, the master key operates a single thick lever (B) which in turn operates the three thinner levers (A) by means of the thrust bar (C).

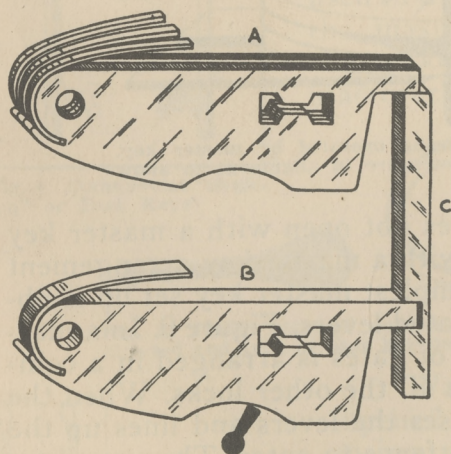


Fig. 11. Master key operates lever B, thereby causing thrust bar C to align levers A.

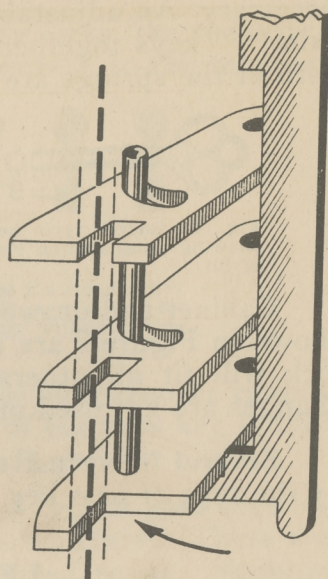


Fig. 10. Exploded view of control lever construction. Lower lever operates upper two. Master key operates only lower lever.

In Figure 12, the bolt arrangement is shown for this type of lock. When the master key operates (B), it retracts (A). To bring back (A) to the unlocked position, the master key is turned once more. Since there is an elongated notch in (B), the bolt will retract without affecting the position of (A).

WAFER TUMBLER CYLINDERS

Wafer tumbler cylinder master key systems require the use of a regular key and reverse keyway blank. Figure 13.

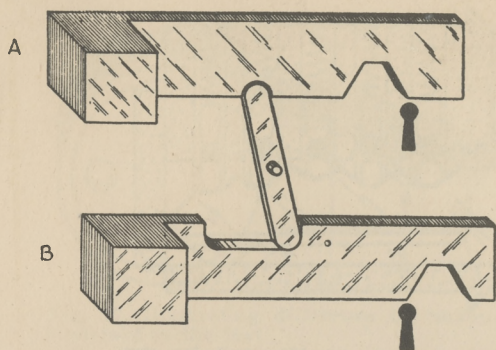


Fig. 12. Bolt arrangement as used with construction shown in Fig. 11.

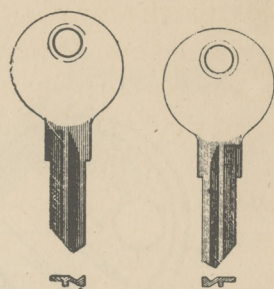


Fig. 13. Regular and reverse keyway blanks for wafer tumbler master system.

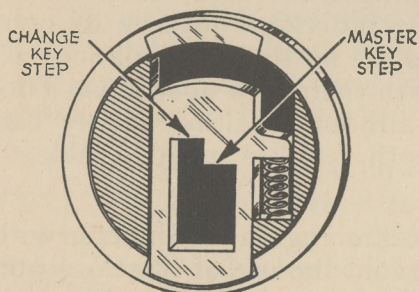


Fig. 14. Cross section view of stepped wafer tumbler.

This is necessary because the wafer tumblers are stepped so that two changes exist on the same tumbler. The regular key raises the tumblers on the left or right hand step, while the master key raises the tumblers on the opposite step. The mastered steps are keyed

alike. Thus the master key can operate each lock in the series if the steps are alike in each lock. However, the combination of steps on the opposite side varies with each lock, thus requiring a different change key for each lock. Figure 14.

PIN TUMBLER CYLINDERS

The principle of master keying a pin tumbler cylinder is simply explained by noting that a cylinder may be arranged with two sets or more of pin tumblers in each pin chamber... each set being brought to the shear line of the plug by a different key. Figure 15. When one key operates a series of locks in this manner, it is called a master key. The key that operates only one lock in the series is called a **change key**.

Before going into the more complicated aspects of master key systems, it would be wise to consider an elementary master key set-up. A good example is a two family house with two entrance doors and one common

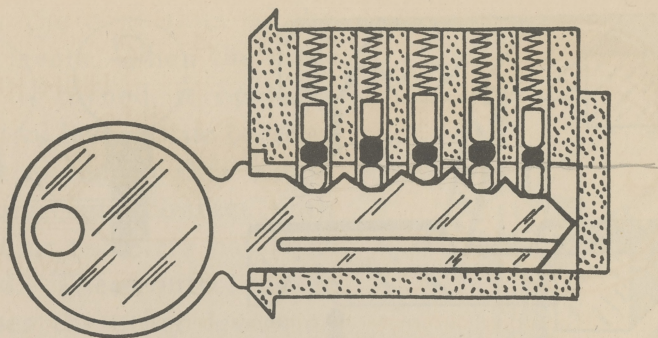


Fig. 15. Cross section view of pin tumbler cylinder containing master pins (black) and regular pins.

vestibule door. Thus three cylinders are involved. It is required that each family have an individual lock on its own door but it is also necessary to set up the vestibule lock so that each family can open it with their own door keys. This has to be organized so that although neither family can open the other's door lock, both families must be able to operate the vestibule lock.

Let us assume that these are regular cylinders, with five pins in each. In order to avoid the use of fractions and decimals, we will specify the **lengths** of the pins by numbers. Figure 16. Number 0 will represent the shortest pin number 1 the next size, and so on to number 5.

The cuts in the key will also be represented by number. The cut that raises a number 4 pin to the shear line will thus be called a number 4 cut. In the case of the 0 pin, no cut in the blank is present, since the full width of the blank is required to raise the 0 pin to the shear line of the plug. See Figure 16.

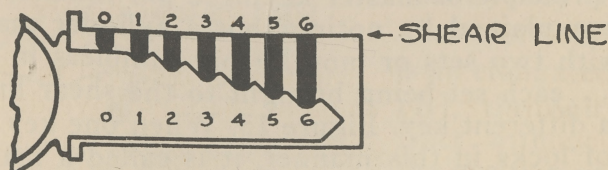


Fig. 16. Relation of pin sizes to depths of cuts in key.

By measuring the cuts of the key we learn that one of the entrance door cylinders is set up with a series of pins (reading from the face of the cylinder) 03542. The other cylinder is set up with the combination 05565. Figure 17.

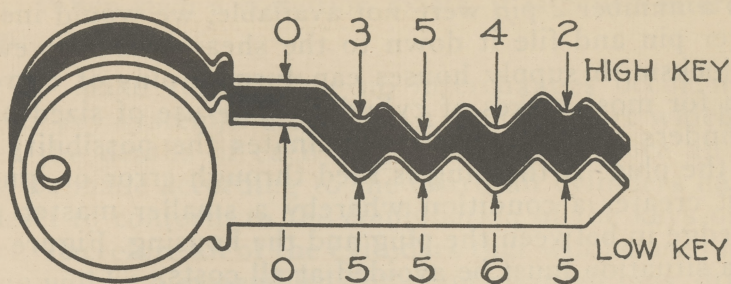


Fig. 17. Illustrating difference in contours between the two keys as explained in the text.

Our problem is to set up the vestibule lock so that both of the entrance door keys will open it. Notice that the two keys have the first and third cuts in common. By setting up the vestibule cylinder to only the first and third cuts of the two keys and eliminating all other tumblers, we have a cylinder that can be worked by either key!

Elimination of pins, however, destroys the security of a lock. The better method to employ is to use two sets of pins in the vestibule cylinder. Notice that the key with the bit reading 03542 is higher than the other. Accordingly, this key will require shorter pins to reach the shear line. Therefore, the first step is to set up the cylinder with the shallow cut key. When this step is completed, the shallow cut key

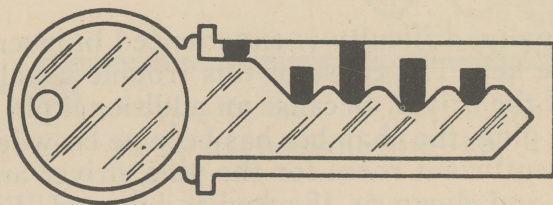


Fig. 18. Pins drop below shear line when low key is inserted.

is withdrawn, and the deeper key is inserted in the plug. Notice in Figure 18 how some of the pins have dropped in the chambers.

Next, fill the chambers with pins that will reach the shear line. The first pin is flush, needing no additional pin, but the second chamber contains a number 3 pin. To fill the chamber to the top of the plug we have to insert a number 2 size pin (2 plus 3 equals 5). This process is repeated in all the chambers until they are filled flush with the shear line.

If a number 2 pin were not available, we would insert a larger pin and file it down to the shear line. However, most locksmith supply houses can furnish pins of correct length for most makes of cylinders. The use of sized pins in cylinders saves time and eliminates the possibility of filing the plug. If the plug is filed through error or ignorance it creates a condition whereby a smaller master pin can wedge in between the plug and the housing. Figure 19. Such a situation must be avoided at all costs.

The plug, being filled with both sets of pins, is replaced in the cylinder housing. Both keys should work freely in the cylinder.

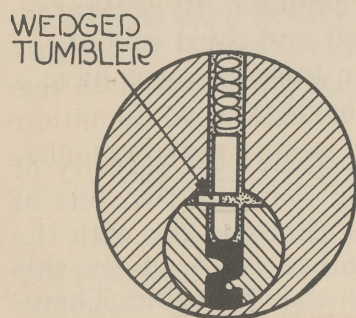


Fig. 19. Tumbler wedged between plug and housing in cylinder with filed plug.

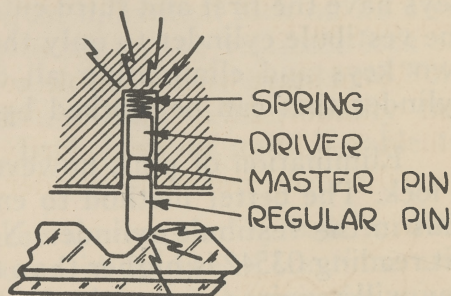


Fig. 20. Crowded condition of pin chamber prevents movement of key.

Occasionally, difficulty is experienced in inserting and removing the key. The cause of this trouble usually lies in the length of the driver. Because an additional pin has been placed in the plug, the chamber has become crowded. There is no longer sufficient room for the pins, driver and spring to move up and down as the key is inserted. Figure 20. The spring is usually compressed until it collapses.

To avoid this, shorter drivers should be inserted. The size of the master pin should be subtracted from the size of the original driver in order to find the proper length for the new driver.

THE APARTMENT HOUSE SYSTEM

We are now ready to consider the problem of setting up a master key system for a larger project—a ten family house. Remember that it is all important to prevent one tenant from being able to use his key to open his neighbor's

door. When such a condition exists, it is called **interchanging**.

To make certain that no interchanges occur in the master key system, we draw up a plan or chart which specifies the depths of each cut of each key. Since all keys must be made according to the chart, all cylinders have to be reset to conform to the combination of the keys on the chart. Therefore all of the cylinders that will be used in the set-up will be disassembled and emptied of all pins, drivers, and springs. A set of keys will be made on a code machine, or from depth key guides according to the cuts specified on the chart.

Let us, therefore, proceed to make up a master key system chart:

We'll start with a simple combination for the first key and cylinder, 2-2-2-2-4. Our trial master key combination will be 2-4-4-6-6. To help clarify the following paragraphs, we will set up the first cylinder.

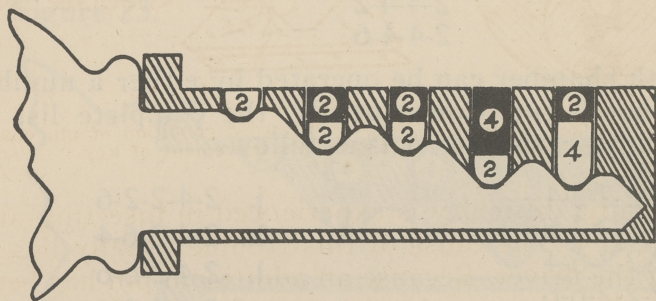


Fig. 21. Trial master key inserted.

In the illustration, Figure 21, the positions of the pins are shown when the master key is inserted. The black pins indicate the master pins. The white pins are the change key pins. The numbers in the pins represent the size of the pins. Notice that the pins vary in size by at least 2 depths. This is necessary to insure security, since a one depth difference would cause interchanges if used in worn or filed cylinder plugs.

In analyzing this set up, let us try to determine if any other key could operate the cylinder. The first pin is a number 2 depth, and therefore operated only by a number 2 cut. The second chamber can be operated by either a number

2 or a number 4 cut. Thus we have two possible combinations so far: 2-2; and 2-4. The third chamber can be operated by a number 2 or a number 4 cut giving us the following possible combinations:

2-2-2
2-2-4
2-4-2
2-4-4

The fourth chamber can be operated only by number 2, or a number 6 cut. (A number 4 cut will move the pin up only 2 depths, causing the number 4 pin to lock in between the plug and the housing.) Thus we have the following possible combinations:

2-2-2-2
2-2-2-6
2-2-4-2
2-2-4-6
2-4-2-2
2-4-2-6
2-4-4-2
2-4-4-6

The fifth chamber can be operated by either a number 4 or a number 6 cut. Consequently, the complete list of possible changes in this series is as follows:

- | | |
|--------------|--------------|
| a. 2-2-2-2-4 | j. 2-4-2-2-6 |
| b. 2-2-2-2-6 | k. 2-4-2-6-4 |
| c. 2-2-2-6-4 | l. 2-4-2-6-6 |
| d. 2-2-2-6-6 | m. 2-4-4-2-4 |
| e. 2-2-4-2-4 | n. 2-4-4-2-6 |
| f. 2-2-4-2-6 | o. 2-4-4-6-4 |
| g. 2-2-4-6-4 | p. 2-4-4-2-6 |
| h. 2-2-4-6-6 | q. 2-4-4-6-6 |
| i. 2-4-2-2-4 | |

In examining this set-up, we see that every one of the keys after the first listing will operate the first cylinder! To make this clear, look at Figure 22. Here, key E has been inserted into the cylinder. Notice how it can operate the cylinder. In the same fashion, Key O will operate the E lock, as well as all other locks from N to A!

If master key systems were organized in this fashion, every succeeding key would become a master key for all

of the cylinders that were set up before it. (See chart for proof.)

The fault, however, is in the selection of the trial master key combination. Let us use a master key with the following combination, 2-2-6-8-8.

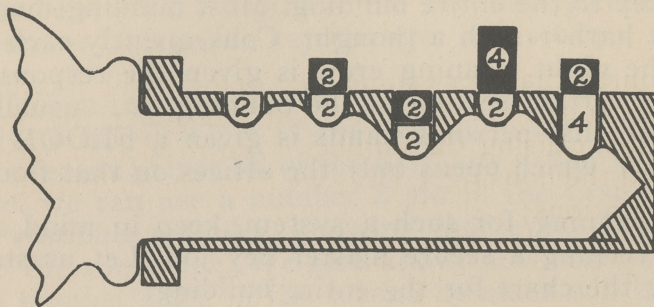


Fig. 22. Key E operates first cylinder.

Using the same set-up in our first cylinder, 2-2-2-2-4, let us insert the new master key and fill the chambers with pins. Figure 23.

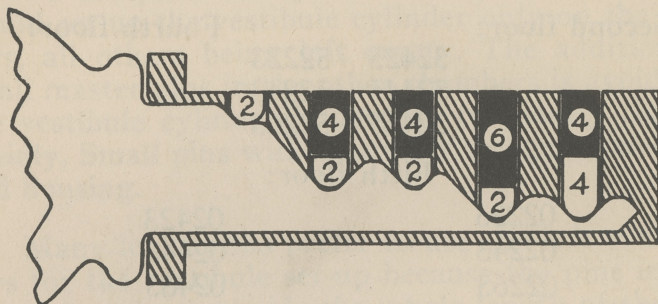


Fig. 23. Correct master key eliminates possibility of interchanges.

The first pin is still flush with the shear line. The second chamber requires a number 4 pin to fill it. Notice that no other cuts except a number 2 or 6 will line up these pins.

In checking the chart we see that none of the keys with a number 4 for the second cut can operate the lock. That gives us 9 set-ups that can be used cylinders I to Q, without fear of interchanging.

Further examination will reveal that the third chamber containing any number 4 pins will also be secure against keys with a number 4 for the third cut. Thus, sets E through Q are usable.

Let us take a five story office building with six offices on each floor. Each one of the locks must be individually keyed as well as mastered. The usual office building has its cleaning done at night by porters and char-women. These persons must be able to get into each office in order to do their jobs. It wouldn't be wise to give each person a master key to the entire building. Most building managers wouldn't harbor such a thought. Consequently each member of the night cleaning crew is given the responsibility of only a certain section of the building . . . usually one floor. Into that person's hands is given a **FLOOR MASTER KEY** which opens only the offices on that floor.

In planning for such a system, keep in mind all the rules governing a secure master key job. Let us start by planning the chart for the entire building.

MASTER: 70007

First floor:		Third floor	
32223	32423	52225	52425
32243	32443	52245	52445
32263	32463	52265	52465
Second floor:		Fourth floor:	
32225	32425	52223	52423
32245	32445	52243	52443
32265	32465	52263	52463
Fifth floor:			
02223		02423	
02243		02443	
02263		02463	

If you will observe carefully, you will see that the first and last pins are the only changes for each floor. In all other respects the changes for each floor repeat. Because of the variations in the first and last pins, the keys will not interchange from floor to floor. These pins are called **Floor control pins**.

Now, taking the first floor, let us cut a key 30003. This key will open every lock on that floor. The last and first pins (Floor control pins) are equal to the cuts on the regular change keys, and the other cuts are the regular master key cuts. Therefore the entire floor will work on that key. This key is now known as a **floor master key**.

Some lock companies overcame the possibility of wedged master pins by providing a cylinder that contains two plug sections. Figure 25. The outer ring section is operated by the master pins. Since each master pin must be long enough to pass through the outer ring, no short pins are used. This construction, therefore, permits a closer range between the depths of the key, thus yielding a greater number of possible key changes in a set-up.

When referring to the chart the rule does not seem to apply to the first pin in the cylinders. But this exception has a reason: Since all of the first cuts in the set-up are the same, we can use a number 2 pin in the first chamber of our **vestibule** cylinder, knowing that every key will raise it to the shear line. We also know, now, that a number 2 or a number 4 pin in the second cylinder will be raised to the shear line by a number 2 pin in set-ups A to H. By adding another number 2 pin to the same chamber, all the keys having a number 4 cut will raise the two pins combined to the line (2 plus 2 equals 4).

To complete the system for our ten family house, we would set up the vestibule cylinder only on the two chambers, all others being left empty. The addition of many small master pins in the other chambers is avoided because the vestibule cylinder is used so frequently that it wears rapidly. Small pins will eventually wedge between the plug and housing.

Many locksmiths prefer to use the last two pin chambers for the vestibule set-up because the pins in that position do not have to ride the whole length of the key when it is inserted. In the case of the foregoing chart, this effect may be achieved by reversing the numbers to read from tip to bow.

COMMERCIAL MASTER KEY SYSTEMS

The principle of the master key system is carried through when mastering large office buildings or industrial plants. For example, the ten family house set-up would represent one floor in an office building, or one building in a factory group.

and a women's on the next. In the case of the building we have as an example, it would not be wise to try to add additional master pins so that the tenants on both floors could use each other's lavatories. In such cases, the problem is overcome by issuing separate keys **for this purpose**. A key with the first and last cuts equal to the floor master key and the others cut to the lowest depths would do the trick. Thus if a tenant on the third floor were going to use the lavatory on the second floor, he would use a key cut 37775. The first and last pins would open the lock and the number seven depths are too low to interchange with any lock in the entire system.

Another method of doing the job is to group the floors in pairs. Use a six pin cylinder and let the first and sixth pin operate the lock. Of course the sixth pin would be working on the tip of the key. Figure 26. Thus, on the first and second floors, you can set up a six pin cylinder to work on the first pin (3) and the tip (the same on all the building keys). But only the two floors that used the number three depth could use the lavatories. The other tenants could not enter because their keys have a number 5 or a number 0 for their first cut. This second method is superior to the first because it eliminates the need for extra keys.

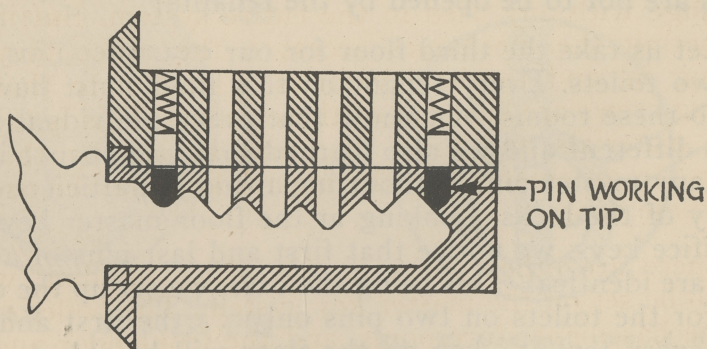


Fig. 26. Tip of key operating last pin.

Now we come to the store rooms. In these rooms the cleaning equipment is kept. The tenants must be kept out of there, and the cleaners who work on other floors must be kept out of there also.

Actually, this is a very simple part of the job. All that has to be done is to set up the cylinder to the floor master and the building master key. The porters and the char-

women can get into these closets with their regular cleaning keys (floor master). But none of them can get into any other closet than the one that is on their particular floor.

There are always vacant offices and those that are being renovated or serviced in a business building. The contractors must have a key to get into these offices to do their work. There are usually four or five contractors who should have keys. There are the electrician, the painter, the plumber, the carpenter, and one or two lesser contractors who should have access to the vacant office. These men have helpers who work with them or who make deliveries of materials. Frequently duplicate keys are issued to these employees. There are sometimes a dozen or so keys that have been issued for the office lock before the job is completed. In such cases it is not safe to permit the duplicate keys to be made for the regular lock. Consequently, a special cylinder is set up for the job. As a matter of fact, there are several such cylinders kept on hand.

These cylinders are set up so that the mechanics can get into the office, use the lavatories but not able to enter any other office or room. The set-up for this job is: 76667. This is also mastered. Any cylinder thus set up will not interchange with any used in the entire system. But it will still permit the mechanics access to the office they are working in, and to the lavatories. Please note that the cleaning crews are kept out of these rooms. This is to safeguard materials and tools that may be left by the mechanics. In an emergency, the master key may be used to open these doors.

There are other doors in this office building which have to be set on the master key system. The boiler room, and the basement storerooms, and the front door and the side doors (if any).

It is usually the policy of the building to keep the front door closed against all but the master keys. In that case, the front door can be set up to the master key change only. If, however, there is a night watchman or elevator man who is not permitted to have a master key, then the front door could be set to a different combination and incorporated into the master key system. Such a set-up would be

This key could also be issued to people who deliver supplies because it would not give access to any other lock in the building.

The office building master key system can be expanded to the point where 10,000 locks can be opened by a Master Key. The Empire State Building in New York City uses such a system. Many large constructions have similar plans in operation.

SECTION MASTER KEY SYSTEMS

When a great many locks are involved, it is expedient to group them into sections. Each section uses the same pin set-up, but the keyways of each section are different. Thus a key from one section may have the same bittings or cuts as a key in another section, but it cannot enter the cylinders of any other section because of the difference in keyways.

A section is determined by the number of locks required. Since it has been established that lock security depreciates when a great number of master pins are added to the cylinder, it follows that smaller systems offer greater security. This is true because fewer pins, and fewer depths are required.

The lock engineer or master locksmith will try to create a number of related small master systems to preserve the security of the locks. Therefore, a section should be a small master system in itself. A wing, a tower, or a small building lends itself to a section. In larger buildings, certain floors are grouped into sections, each section having the same master key system as the other sections, but using different keyways in the cylinders.

The master key for a section is known as a **sub-master** or **sectional master**.

Of course, it is desirable to have one over-all master key to operate every section. Sectional keyways are designed with this purpose in mind. Figure 27 shows a key blank and its cross section that will enter any of the sectional keyways shown beside it. If the master key for one section were duplicated on this blank, the duplicate key

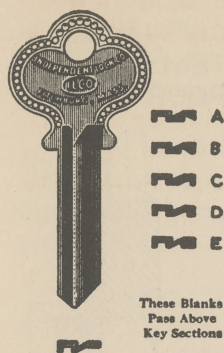


Fig. 27. Master key blank and sectional keyway it can enter.

could enter all the locks in every section and operate them! This key would then be known as the **Master Key**.

Manufacturers use different names to indicate the master key. They range from great grand master to Night Watchman's Key to Superintendent's Control Master Key. But, in effect, they all refer to a **Master Key** as explained above. In this book we prefer to name each key according to its function. Thus a master key for an entire floor would be called a Floor Master. A master key for a building would be called a Building Master, and so forth.

When a large group of buildings are to be mastered as unit, the same problem exists — to develop a number of small systems that can be controlled by one master key. The job is analyzed and planned so that each section has the greatest number of cylinder combinations that can be used without the possibility of creating interchanges. Thus several sectional keyways are used. One manufacturer uses as many as twelve sectional keyways.

In a group of buildings it may be desirable to further sub-divide each large building into several sections. Consequently each Building Master Key must have a keyway that will enter all the sectional keyways of the cylinders in that building — but no other building in the group. A Progressive Master Keyway plan is then used. In Figure 28 you will see how this is done. Notice how the keyways are related and designed.

On a six pin cylinder, it has been proved mathematically by engineers who have used the foregoing principle that it is possible to create a master key system for 100,000 doors.

HOTEL MASTER KEY SYSTEMS

The master key system in a hotel is basically the same as an office building set-up. Requirements, peculiar to the hotel business, however, make certain variations from the

SCHEMATIC MASTER KEY SYSTEM FOR LARGE OFFICE BUILDING GROUP

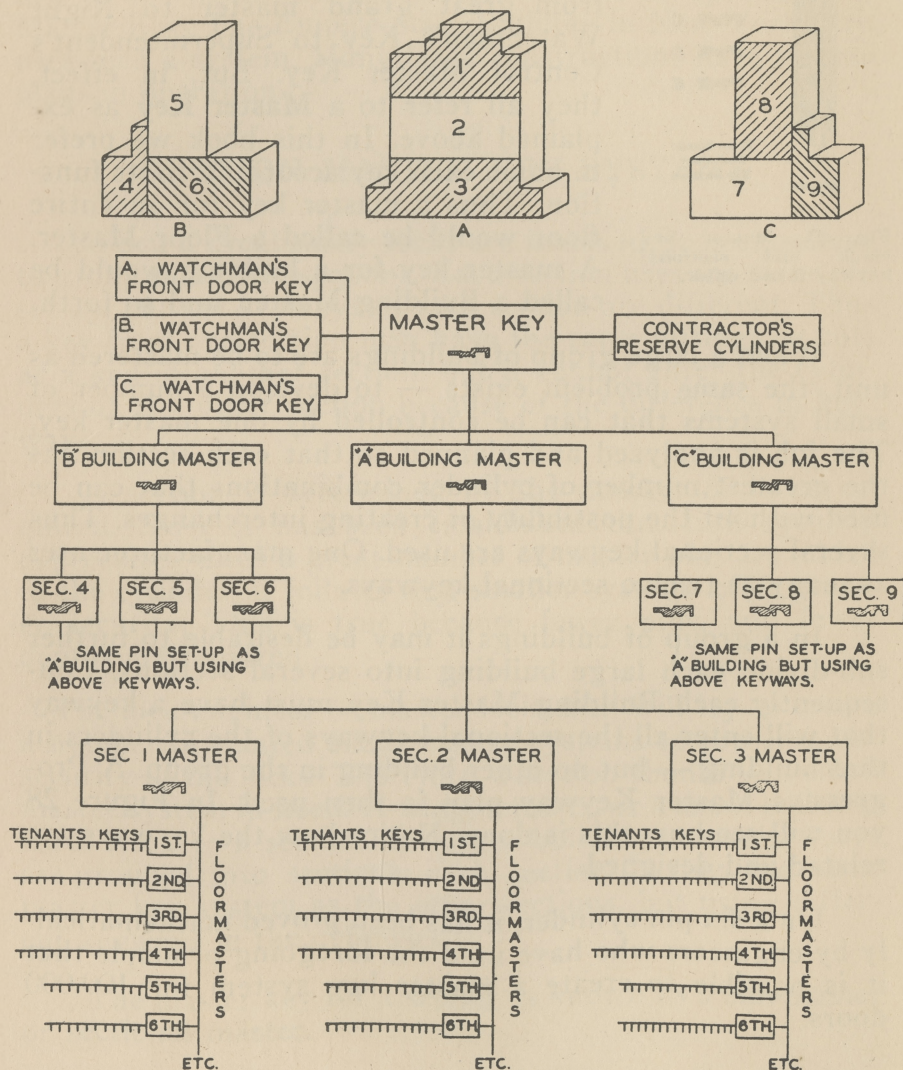


Fig. 28. Plan for Progressive Master Key System for Group of Large Office Buildings.

office building system necessary:

1. A chambermaid needs a floor-master key in order to have access to every room on her floor. Her key is known as the **Maid's Key**.

2. The matron in charge of a group of floor maids should have a key that will open every door on the floors on which her group is working. Her key is called the **Matron's Key**.

3. The general supervisor of the clean-up personnel is known as the Housekeeper. Her key will open all the guest rooms, storage closets, and lockers, in the hotel.

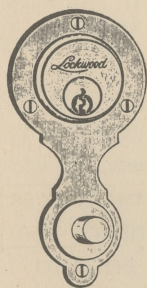


Fig. 29. Occupancy indicator, courtesy Independent Lock Co.

To insure privacy an indicating device is installed on many hotel locks to show the maid that the room is occupied. This eliminates the necessity of trying the key. Figure 29.

Guest room closet door locks were generally keyed and master keyed with the same combination as the guest room door. But the modern tendency is to use a lock on the closet door that will respond only to the hotel manager's Master key. The purpose for this arrangement is to enable the guest to hide any valuables from the cleaning personnel.

The Hotel Manager's Key, just mentioned is also known as a Grand Master Key, an Emergency Key, or a Lockout Key.

This key can open every guest room door—whether locked from the inside or not. Its value lies in the fact that it can be used in an emergency such as illness of the guest, death, or any other extreme case.

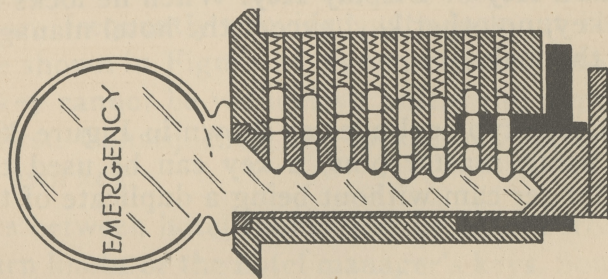


Fig. 30. Cross section view of sleeve and plug arrangement.

Another feature of the Hotel Manager's Key is that it can be used as a lock-out key. Thus a delinquent guest can be barred from entering his room. In Figure 30 the mechanism of the lock-out feature in a cylinder is shown. The cylinder has a plug and sleeve arrangement for the last two pins. The guest's, maid's, matron's, and housekeeper's key operate only the plug and the shorter cam. The Hotel Manager's Key operates the plug and the sleeve, turning both the short and long cams.

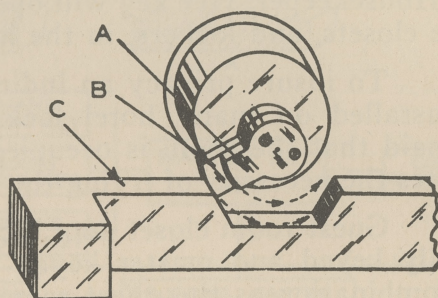


Fig. 31. Long cam reaches bolt mechanism, whereas short cam cannot.

The reason for this arrangement is shown in Figure 31. Notice how the long cam reaches the bolt mechanism. The short cam does not reach it. Therefore, when the bolt is extended by using the lock-out key, or by turning the thumb knob from the inside, the regular keys are not able to retract it because they operate only the short cam.

Many hotels cater to the traveling salesmen's trade. They rent their suite and rooms for display purposes. Where a salesman has expensive merchandise to show, he uses a **Guard Key** or **Display Key**. When he locks his door with this key, no other key, except the hotel manager's key can open the lock.

The sleeve-type cylinder as shown in Figure 30 is used here. By using master pins, a key can be used that will work the longer cam without being a duplicate of the lock-out key!

Of course, an auxiliary lock can be installed on the door to perform the functions of lock-out and display key.

But in their endeavor to eliminate the need for extra keys, they have incorporated both these features in the one door lock.

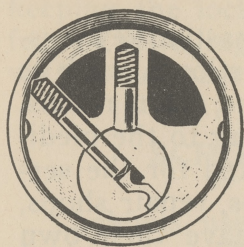


Fig. 32. Cylinder with double set of upper pins. courtesy Sager Lock Works.

Another arrangement for a lock out cylinder is the one shown in Figure 32. Here a double set of upper pins is employed. To create a lock-out, it is merely necessary to insert the lock-out key and to turn the plug to the other set of upper pins. When the lock-out key is withdrawn, the cylinder cannot be operated by any other key.

It should be noted that, when cylinders of this type are employed, the master pin arrangement has to be such that the master pins rest on the cuts of the keys with the change pins immediately above. This is important because when the lock-out key is inserted, it should push all the change pins into the upper chambers so that when the plug is turned to the other set of pins and the key is withdrawn, no change pins are present in the plug to enable a regular key to operate it.

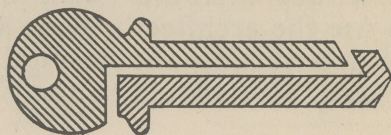
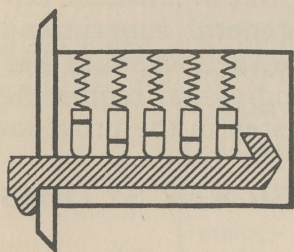


Fig. 33. Lock-out key and its application.

Cylinders without any special arrangement for lock-out keys are frequently provided with lock-out keys such as the one shown in Figure 33. When inserted into a cylinder, this key cannot be withdrawn unless the upper half is inserted first. Consequently the locked-out person cannot insert his own key.

Doors between hotel rooms may be locked from either side by turn knobs or the hotel manager's keys. Some states require that the door be locked from either side by key as well as by turn knob. In such cases, a double cylinder com-

municating door lock with a dead-bolt or dead-latch mechanism is required

HOSPITAL MASTER KEY SYSTEMS

General hospitals employ sectional master key systems. One section will be for the medical portion... such as laboratories, examination rooms, pharmacies, linen rooms, and all of the other rooms directly pertaining to the medical functions. Another section will be created for the service group such as laundries, machine shops, repair shops, etc. The management group, of course, have their own section and are in control of the master keys for the whole system. The responsibility for the master key rests with the general superintendent. Sectional masters and sub-masters (similar to office floor masters) are used by department heads, and minor officials.

The cabinets in which surgical instruments, narcotics, and other items to which only the medical personnel should have access are not usually set up to a master key system. The reason for isolating these items is obviously a safety measure.

In planning a set-up for a hospital or medical center, it is essential to confer with the general superintendent and to use the architect's plans since the locksmith has no way of determining the hospital's individual requirements beforehand. This should be the first step in the procedure.

INDUSTRIAL PLANT MASTER KEY SYSTEMS

The only difference between an office building system and an industrial plant or factory set-up is that the units and sections are dispersed over a large area. Plant buildings are usually set up with sectional or sub-master systems that are controlled by the master key of the plant superintendent.

Provision should be made in industrial systems to permit expansion of several sections or units. Therefore all of the possible cylinder combination variations should not be used in any of the sectional systems. A good rule to follow is: **Use only half of the possible combinations, and use as many sections as required to keep this rule in effect.**

Another reason for the above rule is that because of personnel turnover due to dismissals, resignations and transfers, it is frequently necessary to change the combinations of cylinders. Reserve combinations are used thus keeping the locks under the same master system without fear of installing a new combination that may interchange with some other cylinder.

SCHOOL MASTER KEY SYSTEMS

Schools use a very simple master key system. The chart, Figure 34, illustrates a typical set-up.

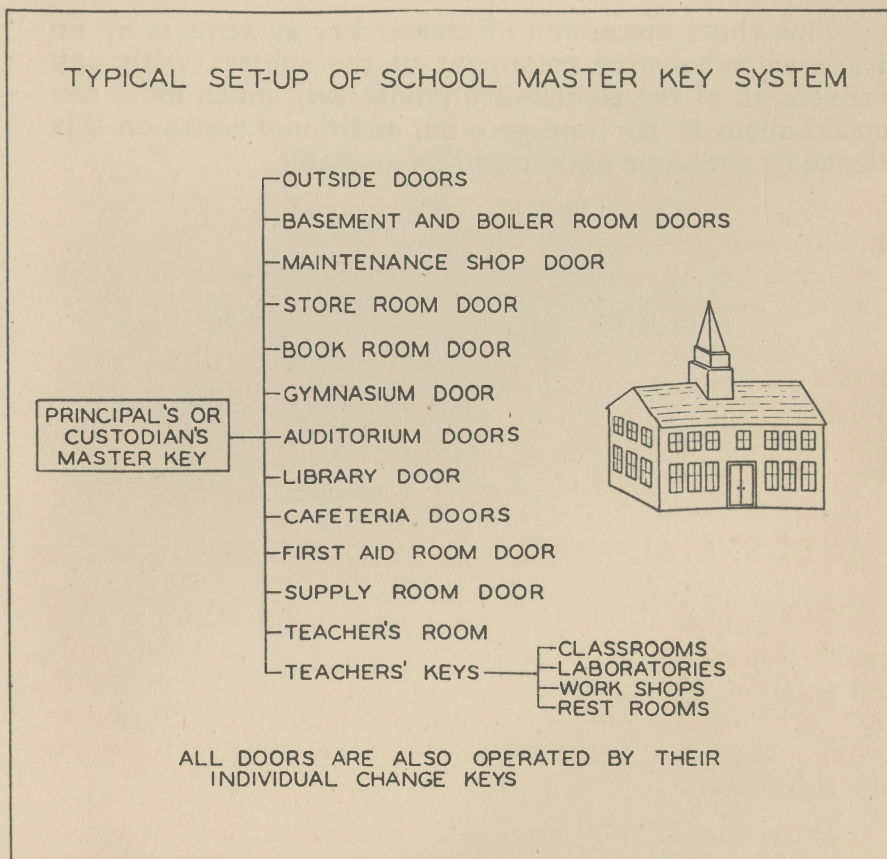


Fig. 34. Plan for school master key system.

Locker locks are installed with a separate master key system. A locker master key system usually involves one master key to open every locker lock in the school. The

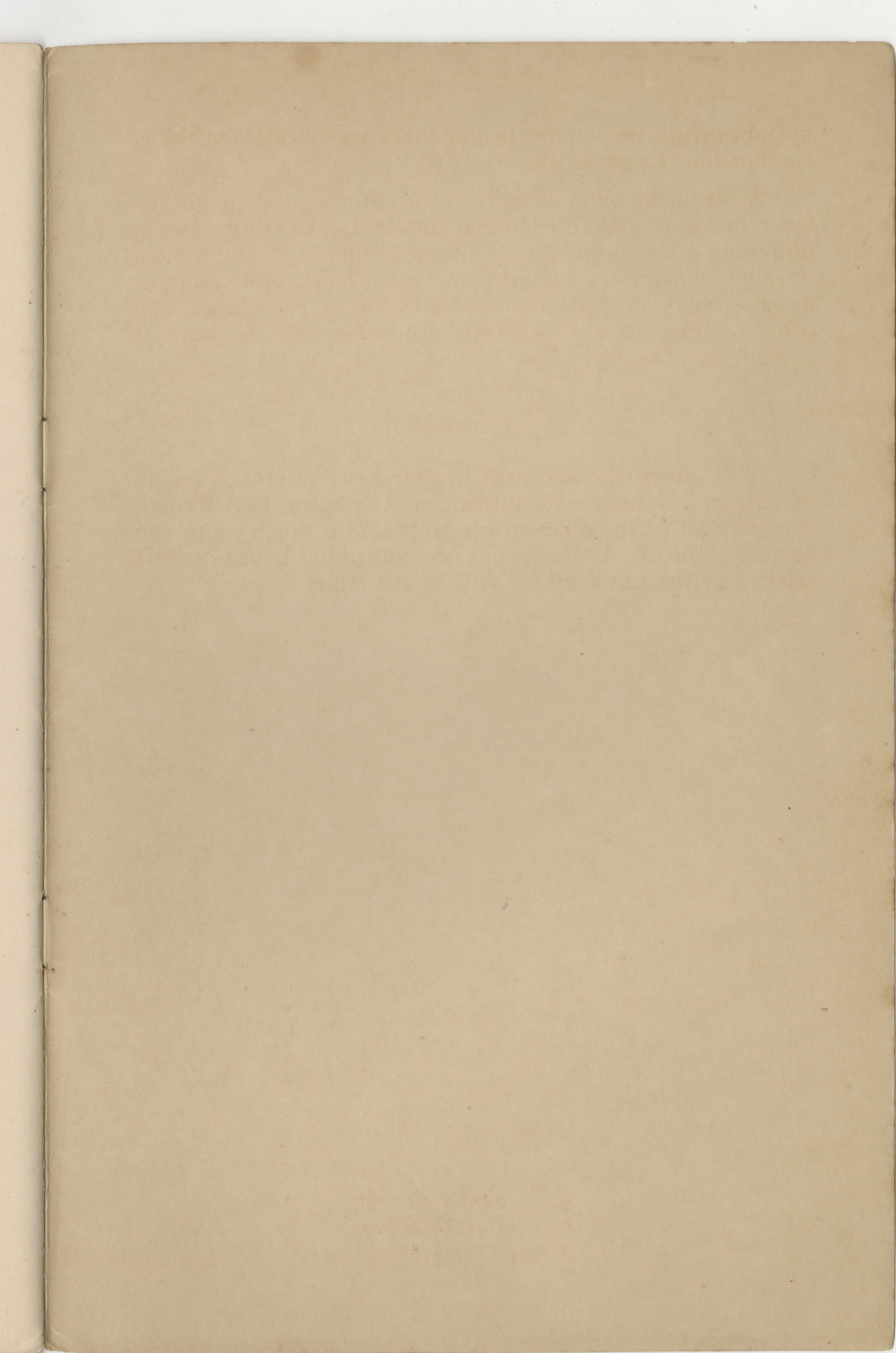
system of master keying locker locks was explained under the heading **Lever Locks**.

Most of the older schools in the country use the bit key lever locks as explained under **Lever Locks**. But modern buildings are cylinder lock equipped. The biggest problem in school master key systems is to keep the system as simple as possible. Constant changes of teachers, room uses, and other factors make it imperative to inaugurate as simple a system as possible.

Conclusion

This short discussion of master key systems is by no means an exhaustive treatment of the subject. Although it covers all of the elementary points, still much more can be said about it. As time goes on, additional books on this science by the same author will be available.

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