



# A LOOK AT MASTER RING CYLINDERS

Good buildings deserve good hardware.

**By Richard Howard, AAADM, CFDAI,  
CPL, DHC, DHT, ICPL, IQP**

**T**HE MASTER RING CYLINDER CONCEPT — A CYLINDER WITH TWO SHEAR lines, both capable of operating the lockset, most recognizable by P.F. Corbin designs — is unique in the world of commercial builder hardware. There is relatively little information available on the subject. This is remarkable given the fact that the cylinder has existed for more than 130 years, invented (or perhaps discovered) just three decades after the patenting of the modern pin tumbler cylinder by Linus Yale Jr.

I have spent the last 30-plus years working in the door and hardware industry, and like most of you, I was pinning locks very early in my hardware career. However, my industry experience and exposure to the greater world of locks, doors and hardware provided all but zero practical exposure to or experience with the master ring cylinder. After taking the time to study the cylinder, I truly wish I had more exposure to it sooner. The master ring is a remarkable invention that addresses the shortcomings of single shear-line cylinders. It also solves a number of keying problems before the problems that plague locksmiths and end users today were even considered as such — most notably, the ability to provide a master-keyed cylinder without key interchange.

## History

In the late 19th century, the master ring was patented (patent #414,720; see Figure 1) by New York City locksmith Edward O’Keefe (who had another very interesting cylinder of a bicentric type, which can be reviewed under patent 582,367). It was intended to prevent unwanted cross-keying combinations inherent in master key systems, and he assigned the patent to P.F. Corbin Lock Company. The master ring cylinder, when in a mortise cylinder configuration, is also known as a “jumbo cylinder.” It’s 1½” in diameter to accommodate the plug, master ring and the portion of the cylinder that contains the springs and top pins. Mr. O’Keefe’s invention was genius, and I

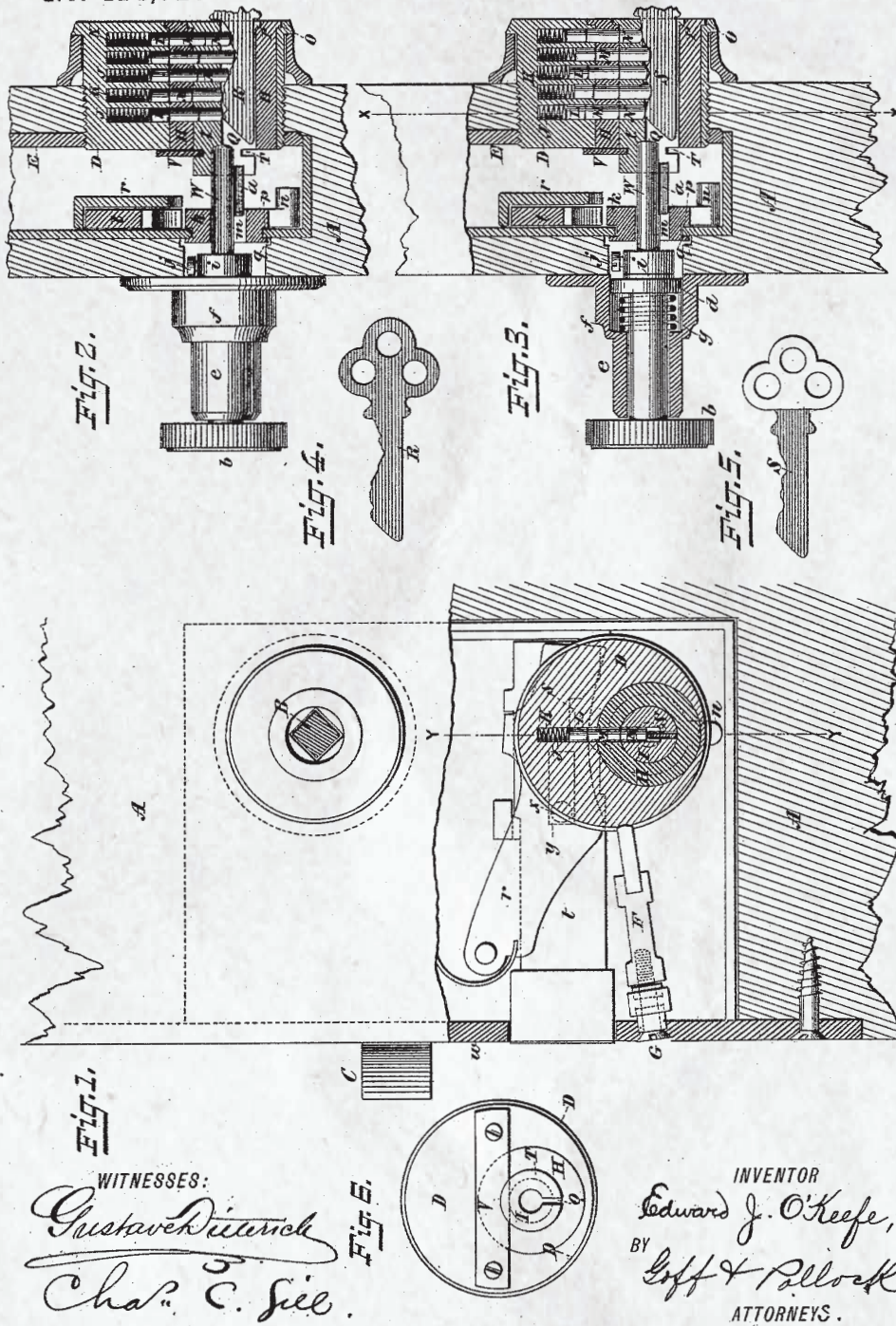


(No Model.)

E. J. O'KEEFE.  
LOCK.

No. 414,720.

Patented Nov. 12, 1889.



R. PETERS, Photo-Lithographer, Washington, D. C.

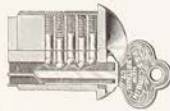
Figure 1. In the late 19th century, New York City locksmith Edward O'Keefe patented the master ring.

# CORBIN CYLINDERS

## BALL-BEARING

Corbin Cylinders contain balls of German Silver to give greater ease of operation, and to reduce the wear by eliminating friction. In the Master Keyed Cylinder, a master ring surrounds the key plug. The Change Key operates the key plug, and the Master Key operates by lining up the breaks in the pins at the outer line of the master ring. This combines, in a single shell, two cylinders using the same key way for both the Change Key and the Master Key.

Corbin Master Keyed Locks are Master Keyed in one set of any number of changes, all different, with a Master Key to pass, or in any number of sets of any number of changes, all different, with Master Keys to pass each set and a Grand Master Key to pass all.



Sectional View of  
No. 253 Cylinder



No. 250



No. 251



No. 252



No. 253. 1 1/4 IN.



Sectional View of  
No. 253 1/2 Cylinder



No. 250 1/2  
Master Keyed



No. 251 1/2  
Master Keyed



No. 252 1/2  
Master Keyed Size



No. 253 1/2. 1 1/4 IN.  
Master Keyed

## UNIT LOCK CYLINDERS

NUMBER	CAST BRONZE	Each
250	Polished	
250 1/2	"	

## RIM LOCK CYLINDERS

### CAST BRONZE

NUMBER		POLISHED	R FINISH	SR FINISH	F FINISH ‡
251	Each				
251 1/2	"				

## DUMMY CYLINDERS

### CAST BRONZE

NUMBER		POLISHED	R FINISH	SR FINISH	F FINISH ‡
252	Each				
252 1/2	"				

## MORTISE LOCK CYLINDERS

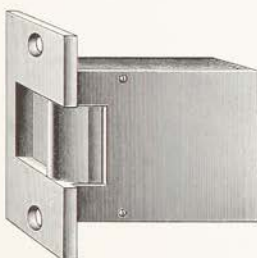
### CAST BRONZE

NUMBER	INCH		POLISHED	R FINISH	SR FINISH	F FINISH ‡
253	1	Each				
	1 1/4	"				
	1 1/2	"				
	1 3/4	"				
	2	"				
253 1/2	1	"				
	1 1/4	"				
	1 1/2	"				
	1 3/4	"				
	2	"				

State length

# ELECTRIC DOOR OPENERS

## CAST BRONZE



No. 630

NUMBER	FOR LOCKS		POLISHED	R FINISH	SR FINISH	F FINISH ‡
630	Nos. 560B, 561B, 1334B, 1339B, 01339B, 564B, 567B, 0567B, etc.	Each				
631	Nos. 2020, 2038, 2039, 02039, 2058, 2061, 2062, 2062 1/2, 2063, 2063 1/2, 2064, 2066, 2067, 02067, etc.	"				

Prefix letters for finish. Description of finishes, page VI ‡ Rustless iron

Door Openers, One in a Box, with Screws

PRICE BOOK, SECTION NO. 6

Figure 2. The earliest direct reference to master ring that the author found is in the product catalog from 1905.

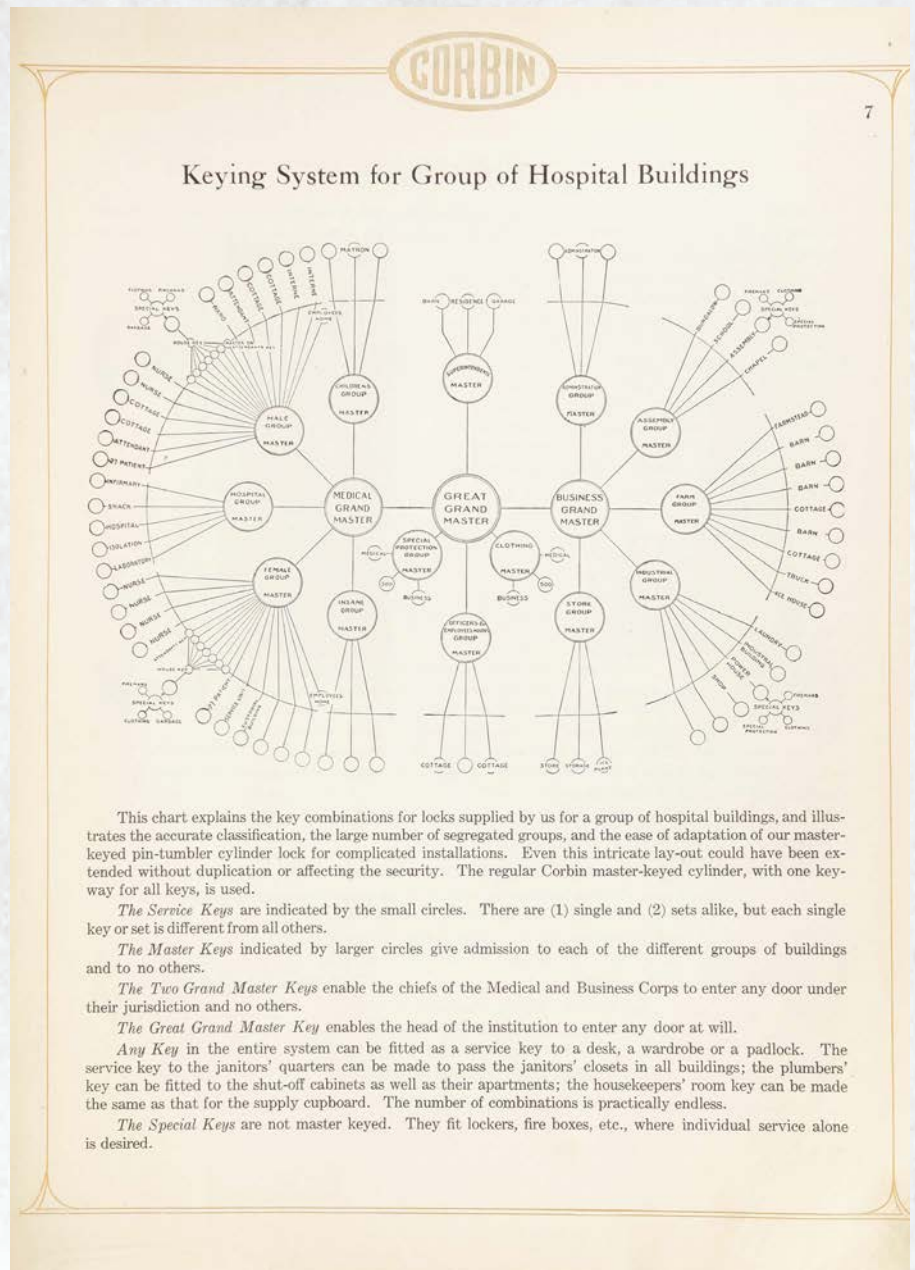


**“I admire the master ring platform, its capabilities and its 120-plus years of heritage. I believe it is simple and elegant.”**

believe the fullest impact of the master ring technology was not immediately appreciated. In fact, it was certainly an invention decades before its time.

I have several late 19th century and early 20th century P.F. Corbin catalogs (scans of catalogs, not the original texts), and the earliest direct reference to master ring that I see is in the product catalog from 1905 (Figure 2). There, the company lists single shear line and master ring cylinder options available for unit locks, as rim, mortise and dummy cylinders — although it’s unclear if the dummy cylinders are rim or mortise.

Corbin does not specifically mention the larger cylinder diameter but does imply this by drawing larger cylinders to represent the master ring product. Corbin offered the common single shear line pin tumbler cylinder prior to the inclusion of the master ring-type product (and even offered these cylinders alongside flat steel key, bit key lever tumbler locks, as seen in their 1895 product catalog). The company describes the function of the master ring cylinder as follows: “In a master keyed arrangement, the Master Ring surrounds the key plug. The Change Key operates the key plug, and the Master Key operates by lining up the breaks in the pins at the outer line of the Master Ring.” Corbin



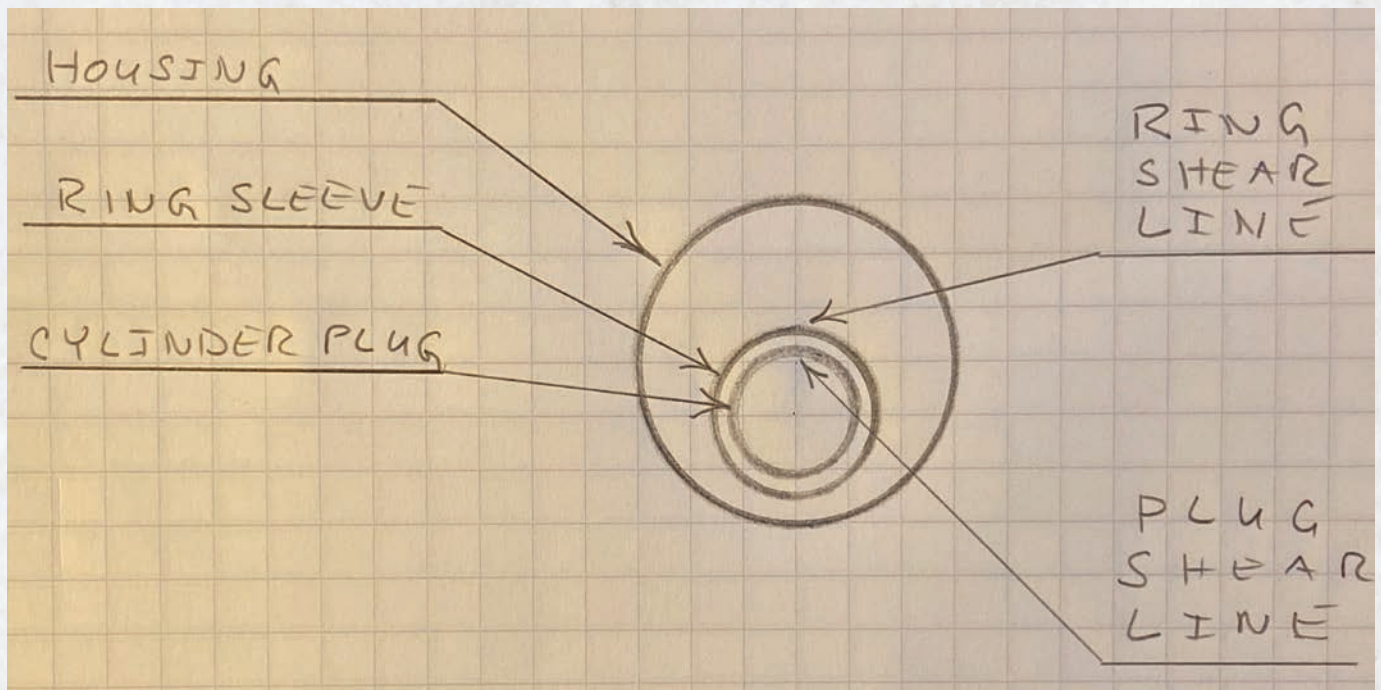
**Figure 3.** At the time of the master ring’s inception, master keying theory was perhaps slightly less evolved than it is today.

goes on to state the above arrangement “combines in a single shell, two cylinders using the same keyway for both the Change Key and the Master Key.”

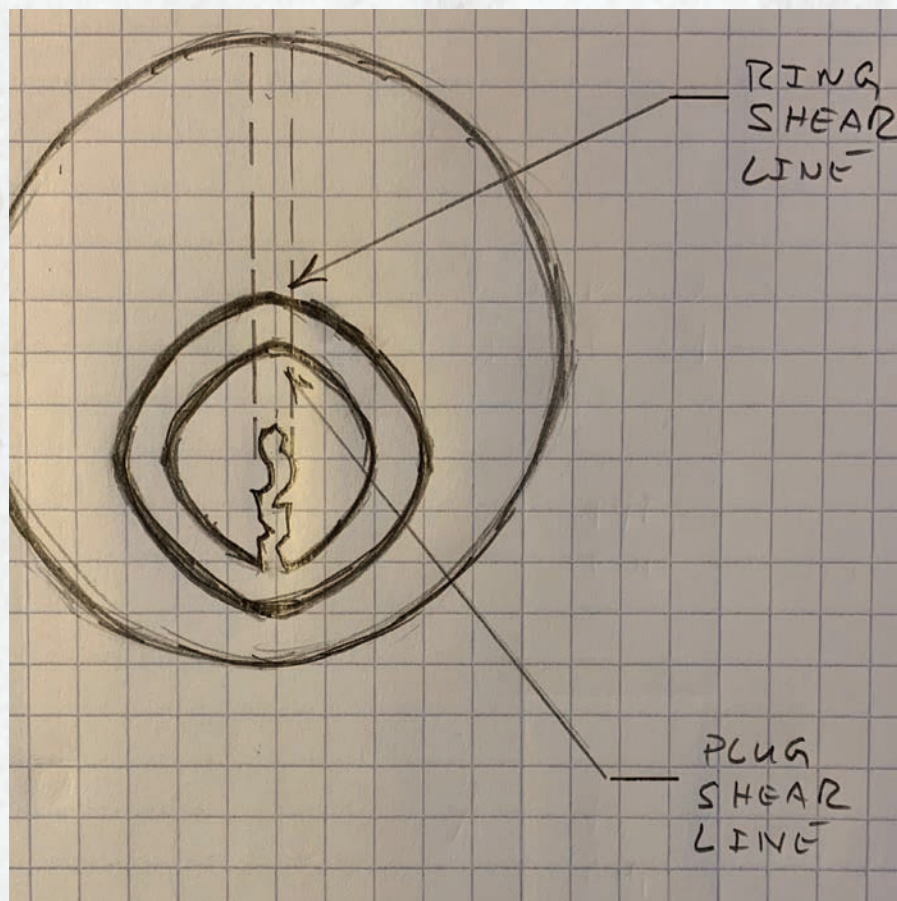
The company very clearly marketed the master ring for use when requesting master keyed cylinders and seemed to suggest traditional single shear line construction for non-master-keyed re-

quirements. This tells me the problem or at least the threat of incidental keys was real, and given the fact the company marketed changes as “unlimited,” it had to back that claim. This also reveals an understanding of master keying theory as sound in its conception, although perhaps slightly less evolved (Figure 3) as it stands in the 21st century.





**Figure 4.** This drawing provides a cross section of the master ring cylinder.



**Figure 5.** Shear Line location of Master Ring Cylinder

### Principles of Design

The design of the master ring cylinder is simple and elegant (Figure 4). This cylinder design maximizes the potential bittings available in a cylinder, eliminates incidental master keys (also known as “ghost” keys) and is commonly understood, on average, as more time-consuming and resistant to picking and impressioning while not eroding the security of the cylinder whatsoever.

The master ring mortise cylinder, a 1½" diameter Grade 1 cylinder meeting ANSI/BHMA A156.5 standards, features two components capable of rotating independently of each other, creating two shear lines (Figure 5). The lower shear line is called the plug shear line, and the upper shear line is called the ring shear line. These two shear lines are made possible by the master ring sleeve (Figure 6), which surrounds the cylinder plug (Figure 7). The master ring sleeve has a definite thickness that’s taken directly into account when pinning the cylinder to solve the ring shear line. The plug shear





**Figure 6.** Photo of Master Ring removed form Mortise Cylinder



**Figure 7.** Photo of Cylinder Plug partially inserted into Master Ring

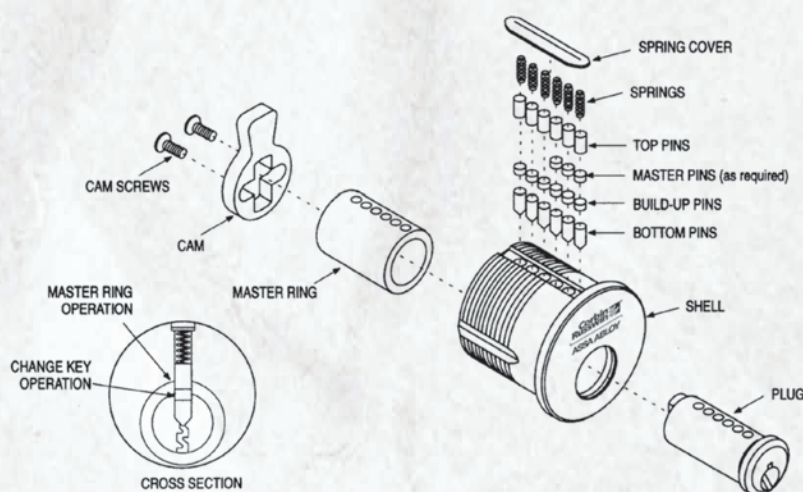
line is created by the area at the top of the plug and the bottom of the master ring sleeve. The second shear line is created by the area between the top of the master ring sleeve and the bottom of the cylinder shell. The master ring sleeve fits inside of the cylinder shell, and the cylinder plug fits inside of the master ring sleeve.

This design allows the separation of key levels, which are to be pinned separately, very much like the Yale Bicentric cylinder. The Yale cylinder was specifically intended to isolate master key bittings from change keys and prevent key interchange. The master ring cylinder is different in that both shear lines are within a single cylinder, which is a tenet of combining the master ring cylinder. I believe the master ring is superior, as the pin tumblers that satisfy the ring shear line are unavailable to visual review and unlikely for someone to impression a key at the ring shear line. Decoding is hampered when direct access is not available.

## Combining

Having reasonable command over keying theory and the general concept of the “build-up pin” is assumed for this section. If you don’t, review the master ring section of the CR Cylinder Manual

## Master Ring



**Figure 8.** The master ring section of the CR Cylinder Manual can be helpful in understanding keying theory and the general concept of the “build-up pin

(Figure 8). We will be continuing to use the Z-Class System 70 as our reference.

Combining the master ring cylinder starts out like conventional cylinders simply enough in that you start pinning your cylinder just as if you were pinning a Level 1 cylinder. In master ring, you first pin to the change key, which is pinned at the plug shear line. Your bottom pins (sized 1, 2, 3, 4, 5, 6) will always match

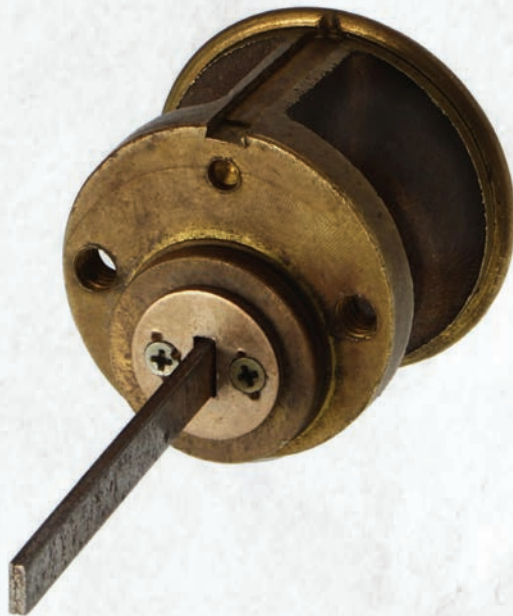
the change key bitting. No other pins are to exist in the cylinder plug when shear is created with the plug shear line and change key.

Next comes the ring shear line. This is where your build-up pin (BUP) and any master wafers will exist. These pins together will permit the TMK and any masters to operate at the ring shear line. Because master ring is customarily master





**Figure 9.** Front View of typical Master Ring Rim Cylinder



**Figure 10.** Rear View of typical Master Ring Rim Cylinder

keyed only at the ring shear line, master wafers are usually found above the BUP in any given chamber. If master pins are found below the BUP, perhaps the cylinder was maison pinned at the plug shear

line or just simply pinned not according to master ring best practices.

The new concept here is the BUP, and if you're accustomed to LFIC or Corbin Russwin IC, then it's a familiar term. To

define the BUP, we need to state that the thickness of the master ring sleeve component of the cylinder assembly is equal to a BUP of 0. The master ring sleeve is either .142" or .163" thick, depending on the plug diameter. Therefore, the BUP 0 pin is either .142" for the .552" plug diameter or .163" for the .509" plug diameter.

Since the OD of the cylinder is 1½" regardless of plug diameter, the thickness of the ring sleeve must be the variable to accommodate the plug diameter in use on that cylinder. This represents the "build-up dimension." The BUP used is based on not only the bitting class but also the system employed (System 70 or Pre-System 70). There is a full complement of BUP sizes available in the Corbin Russwin PK-1070 pin kit to accommodate any environment you are pinning in.

Our example system has 10 sizes of BUP from -4 through +5 (the '+' is not used when describing these BUP when longer than the 0 BUP, but only used just here for illustration purposes). In order, these would be -4, -3, -2, -1, 0, +1, +2, +3, +4 and +5. These are the same pin sizes, meaning the number and not length of the pin, for .509" and .552" plug diameter. The only difference is the actual length of each of the pins in the array, including the 0 BUP — again, based upon bitting and the system class. As an example, a +3 BUP in .509" = .247", and the +3 BUP in .552" = .226".

There are then master pins that (in our current example) would be sized 1, 2, 3, 4 and 5. BUPs and master wafers are not the same and therefore cannot be used interchangeably.

Finally, there is the top pin. For purposes of master ring, the top pin will always be .171". However, in the greater world of Corbin Russwin, the length of the top pin is also based on the class of bitting and the cylinder type being pinned. Mortise and rim cylinder front





**Figure 11.** J415 Spool Pin



**Figure 12.** Photo of PK-1070 Pin Kit

view (*Figure 9*) and rear view (*Figure 10*) top pin lengths, which are .171", will differ from the cylindrical cylinder top pin length, which is .090" or .099, depending on the class.

Spool top pins are usually available for the application but not for all cylinders and class applications. According to Corbin Russwin, "spool pins are used to increase pick resistance. They are available in three sizes, designated by the letter 'J' followed by the length in thousandths of an inch. They are J171, J230, J320 and J415" (*Figure 11*). (Four sizes are actually listed in the CR Cylinder Manual, not three).

The J171 and J320 would be used in master ring. The J320 would be the length needed to block the master ring sleeve. The J415 would be supplied when ordering "0" bitted cylinders. Also, according to Corbin Russwin, "Do not put spool pins in all chambers. Always use a standard top pin in the back chamber to hold the plug in position until the key is fully inserted." I recently ordered a "0" bitted flexible head cylinder, and it indeed shipped with all spool top pins.

Our combining discussion takes us to the new concept in pinning master ring cylinders. The determination of bot-

tom pin and top pin is elementary, and therefore our focus will be in a new area. This new concept is how to determine the BUP to use. There are only two examples needed to fully illustrate the combining process. These are the Level II structure and the Level III (and beyond) structure.

The following is an example of a Level II system:

- a. Pin the plug shear line to the change key.
- b. If your TMK is a cut deeper than your change key, use a +BUP. If your change key cut is a 2 and your TMK cut is a 5, use a 3 BUP.
- c. If your TMK cut is shallower than your change key, use a -BUP. If your change key is a 5 and your TMK is a 2, use a -3 BUP.
- d. If your TMK is the same cut as your change key, use a 0 BUP.
- e. Add your top pins and springs and secure your slide cover.
- f. You're done.

The following is an example of a Level III (or beyond) system:

- a. Pin the plug shear line to the change key.

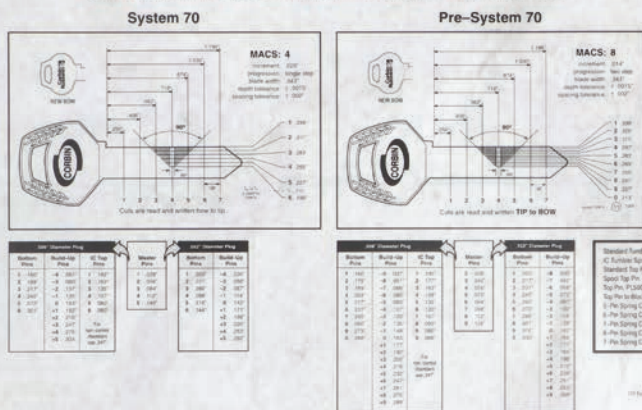
- b. Take the shallowest cut of all your MK(s)/TMK and add that BUP. If your change key cut is a 2 and your shallowest master key cut is a 4, use a 2 BUP. If your next master key cut is a 5, add a 1 master wafer.
- c. If your change key cut is a 2 and your shallowest MK(s)/TMK is a 1, use a -1 BUP. If your TMK is a 5, add a 4 master wafer.
- d. If your shallowest MK(s)/TMK is the same cut as your change key, use a 0 BUP. Add the appropriate length master wafer if applicable.
- e. Add your top pins and springs and secure your slide cover.
- f. You're done.

## **Servicing, Service Equipment and Supplies**

Service equipment is available from Corbin Russwin. The Corbin Russwin PK-1070 deluxe pin kit (*Figure 12*) is, according to the manufacturer, "Ideal for locksmiths and distributor service personnel who must service a variety of Corbin Russwin keying systems. Also for end users with Pre-System 70 keying systems." Also: "Contains all pins required to combine standard, IC and master ring cylinders. Accommodates System

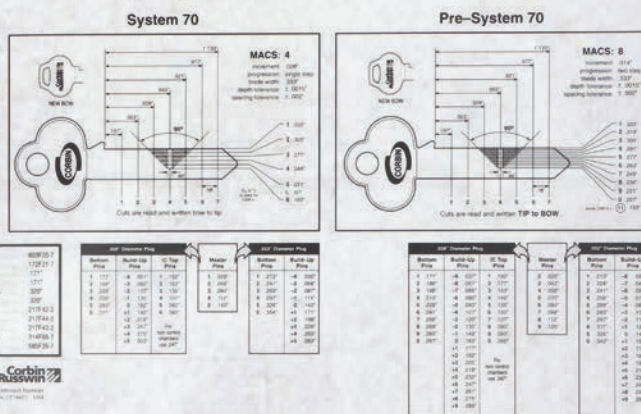


**Applies only to 59 Series, 60, 70, L Series, and restricted keyways not listed for security purposes**



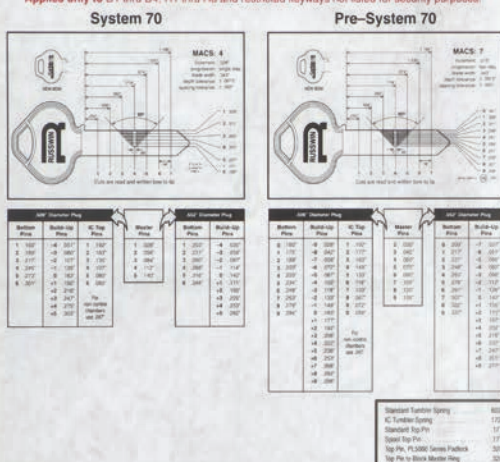
**Figure 13**

**Applies only to 27 Series, 57 Series, 67 Series, 77 Series, 97, 99, AR, BR, BR**



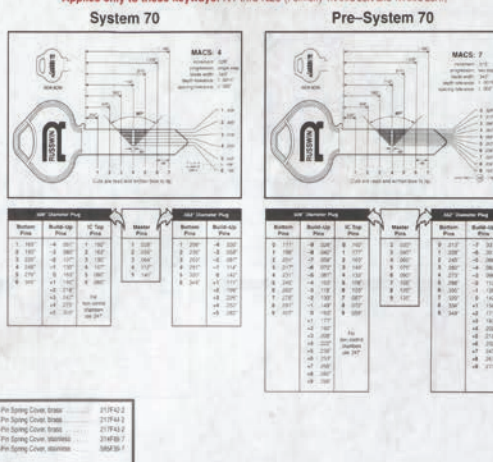
**Figures 13-15.** The pin kit contains a two-sided chart, tweezers and both diameters of plug followers.

**Applies only to D1 thru D4, H1 thru H8 and restricted keyways not listed for security purposes**

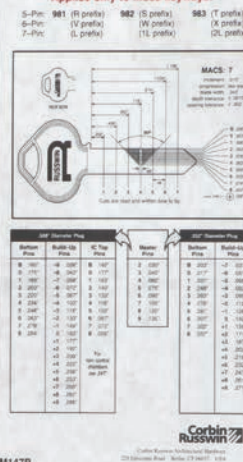


### Figure 14

**Applies only to these keyways: N1 thru N28 (Formerly 1N thru 28N and 1K thru 28K)**



Applies only to these keyways:



70 and non-System 70 for both plug diameters and all key classes. Furnished in a reinforced steel case with combining instructions on the inside of the lid. A separate, removable, two-sided chart, side 1 and side 2, contains pin lengths for all modern key classes. Includes tweezers and both diameter plug followers.” (*Figures 13-15*)

When pinning master ring, it's best to use factory original pins. Attempting to

use a “universal” kit will reveal the lack of all the proper length pins. Finally, shim-  
ming open a master ring cylinder is not  
more or less difficult than a single shear  
line cylinder.

## Availability

The Master ring construction is available in mortise and rim cylinders, unit locks, mortise locks, windstorm rated multi-point locking hardware and as applied

to exit device trims.

The Corbin Russwin ML2000 Series mortise locks offer master ring options in escutcheon and sectional trim, in nearly all functions. Specify “-MR” when ordering. Master ring is also an option on ML-2000HS High Security and ML2000VR Vandal Resistant trim when “a greater degree of security and vandal resistance not found on other mortise trims” is desired.

Master ring is an option with the





**Figure 15**

Corbin Russwin ED7400 series narrow stile crossbar surface vertical rod Grade 1 exit device operators.

The Corbin Russwin FE6600 Series multi-point deadlocking lock system is available fire-rated and is UL listed for windstorm compliance and Florida building code compliant rated. It can meet tornado and hurricane shelter guidelines and be ordered with master ring as well.

Corbin Russwin offers master ring in their UT5200 series unit lock. However, only the Essex lever design is offered. Master ring cylinders can still be purchased for the discontinued CK4200 Grade 1 knob lock. This cylinder design is available in mortise cylinders of the standard, flexible head and dummy variants for use in mortise locks, multipoint and exit device trim along with rim cylinders.

The standard master ring mortise cylinder is available in 11 sizes from 1" up to 3" in length, with five cams offered in 5-, 6- and 7-pin options, with a variety of cylinder collars (and even the wave washer) in 14 standard finishes.

The flexible head version of the master ring cylinder is available in three sizes from 1" length up to 1¼" length, with five cams offered and in 5- and 6-pin cylinder

lengths, with a variety of spacer collars in 14 standard finishes.

### Advantages

Some advantages of the master ring cylinder are:

1. The most substantive advantage to the master ring cylinder is the separation of your change key bittings from your master key bittings. The ability to insulate the master key bitting from your change key bittings very effectively masks the bitting of your master key(s) and your TMK.
2. The structure permits a substantially greater number of theoretical change keys available to you.
3. It physically prevents a visual inspection of the master ring shear line.
4. I understand the general consensus of the locksmith community is the master ring cylinder is inherently more difficult and at a minimum more time consuming to pick as a result of the two shear lines, and made even more challenging by the use of spool drivers. A highly paracentric keyway (*Figure 16*) will also serve to enhance the cylinder's pick resistance along with restricted key blanks to make access to them less convenient.



**Figure 16.** This image is of a Corbin Russwin H4.

5. It's unlikely to be successfully bumped when pinned as it was originally designed.
6. You have access to the huge library of P.F. Corbin, Russell & Erwin, Emhart and Corbin/Russwin Key Bitting Classes. While key blanks and cylinder types are not available with some of the older bitting classes, the pool of available products is massive. For instance, the Corbin X Class developed between 1890 and 1968 and the Z class introduced in 1959 are both still active today for new keying systems. Using these legacy systems would be an advantage to continue to service an older existing installation.
7. According to Corbin Russwin "6-pin Master Ring keying systems offer keying capacity similar to 7-pin conventional cylinder systems."
8. A 7-pin cylinder will yield an enormous amount of theoretical changes and, when teamed up with a multiplex structure, the boundaries are all but "unlimited."



Z-Case System 70 Master Ring KBA  
MACS=4

MK KBA SOP		C	e	f	g	d	a	b	
TMK		2	3	6	4	1	5	2	↑
TPP =	15,625	3	4	1	5	1	6	3	↓
MK'S UNDER		4	5	2	6	↑	1	4	MASTER
THE TMK		5	6	3	1	↓	2	5	KBA
15625 = 5 <sup>6</sup>		6	1	4	2	↓	3	6	↓
		1	2	5	3	↓	4	1	↓
233,280		3	4	1	5	2	6	3	↓
CK'S in		4	5	2	6	3	1	4	↓
KBA		5	6	3	1	4	2	5	CHANGE
(6 <sup>6</sup> )5		6	1	4	2	5	3	6	KBA
		1	2	5	3	6	4	1	↓
		2	3	6	4		5	2	↓
CK KBA SOP		F	b	g	C	d	e	a	

Figure 17. This shows the master ring KBA developed by the author.

9. There is a substantial freedom in the designing of bittings whereby you separate the TMK and MK bittings from the changes.
10. It's inherently less prone — and at the plug shear line, in most cases fully insulated — to exposure to ghost keys. Implementing a rotating constant method when it serves the requirements of a new system only reinforces these advantages.
11. It's commercially available in an adequate diversity of hardware items, which makes for a dependable deployment of hardware on the project. Coupled with the current climate demand from the market for plenty of design and finish options for trim, this allows the owner to purchase beautiful builder's hardware as well.

12. The technical support department at Corbin Russwin is very responsive, willing and capable of assistance with application questions. However, the mechanics of physically combining the master ring cylinder might be best learned by experimentation and self-education using the CR Cylinder Manual directly, and with other sources as your guide.
13. The Corbin Russwin name is ubiquitous and universally familiar to industry professionals, and the name is tried, true and trusted.

### Applications

Applications for the master ring cylinder were originally those installations where a master or grand master, etc. key structure was specified. Every project was a candidate for master ring work from "homes of

modest proportions" to buildings of incredibly expansive proportions such as the Empire State Building or those where intricate keying requirements were required. In today's world, I am unaware of a project that could not be accommodated because of the limitations of single shear line cylinders, but I am aware of exploitations made on large single shear line cylinder installations that a deployment of master ring cylinders would have thwarted. Using our earlier logic, what would be better than a deployed structure of master key cylinders? One that would be more resistant to bumping, impressioning, picking, decoding all while providing substantially greater cylinder integrity and finally an exponentially greater degree of expansion. If you were given a choice, which would you prefer?



## Conclusions

I admire the master ring platform, its capabilities and its 120-plus years of heritage. I believe it is simple and elegant. However, my admiration may just be the twinkle in my eye for those special products in our industry that we enjoy working on and talking about.

When I asked a fellow attendee (not just any attendee — in fact a leader, organizer and industry pillar to locksmithing) of ALOA 2019 to review my master ring KBA (*Figure 17*), he asked, “Why are you even writing about this? They don’t even make them anymore.” While the hardware is still available, his response forces us to focus on the actual circumstances of master ring: a lack of relevance. The needs of the market in 1919 were orders of magnitude less detailed and exacting as are the needs of

the market in 2019 and beyond, and the single shear line cylinder, its development and evolution has continued non-stop. The master ring structure has had no evolution since its inception except that it evolved out of the single shear line cylinder to stem a known weakness in that design. Before deciding to invest in a new master ring system, the end user must analyze the needs of the system for both the current time and the future before investing in an antiquated, limited system, as measured by today’s standards.

Is it possible Corbin Russwin continues to offer master ring so it can service large, existing, decades-old installations of the master ring and that in 10, 20 or 30 years, this cylinder will become obsolete? Certainly. Will it be remembered for the epic-scale installations it

served for decades? Absolutely.

## Further Reading

- Corbin Russwin Cylinder Manual
- *Book Three Servicing Interchangeable Cores and Master Ring Cylinders* by G.L. “Gerry” Finch
- *Interchangeable Core Cylinder Service* by Robert G. Sieveking, 2014 ISBN 978-1-935920-40-3



**Richard Howard, AAADM, CFDAI, CPL, DHC, DHT, ICPL, IQP,** has 30-plus

years industry experience working in distribution specializing in hollow

metal, wood doors and commercial hardware. An active member of both ALOA and DHI, he enjoys the ever-changing and challenging field of locksmithing.