The KABA MAS X-09™ High Security Safe Lock.

A Hands-On Presentation at LockCon 2008.

Sneek, The Netherlands, 10 Oct 2008, Michael U. Huebler.

TOOOL
The Open Organisation Of Lockpickers

LockCon 2008

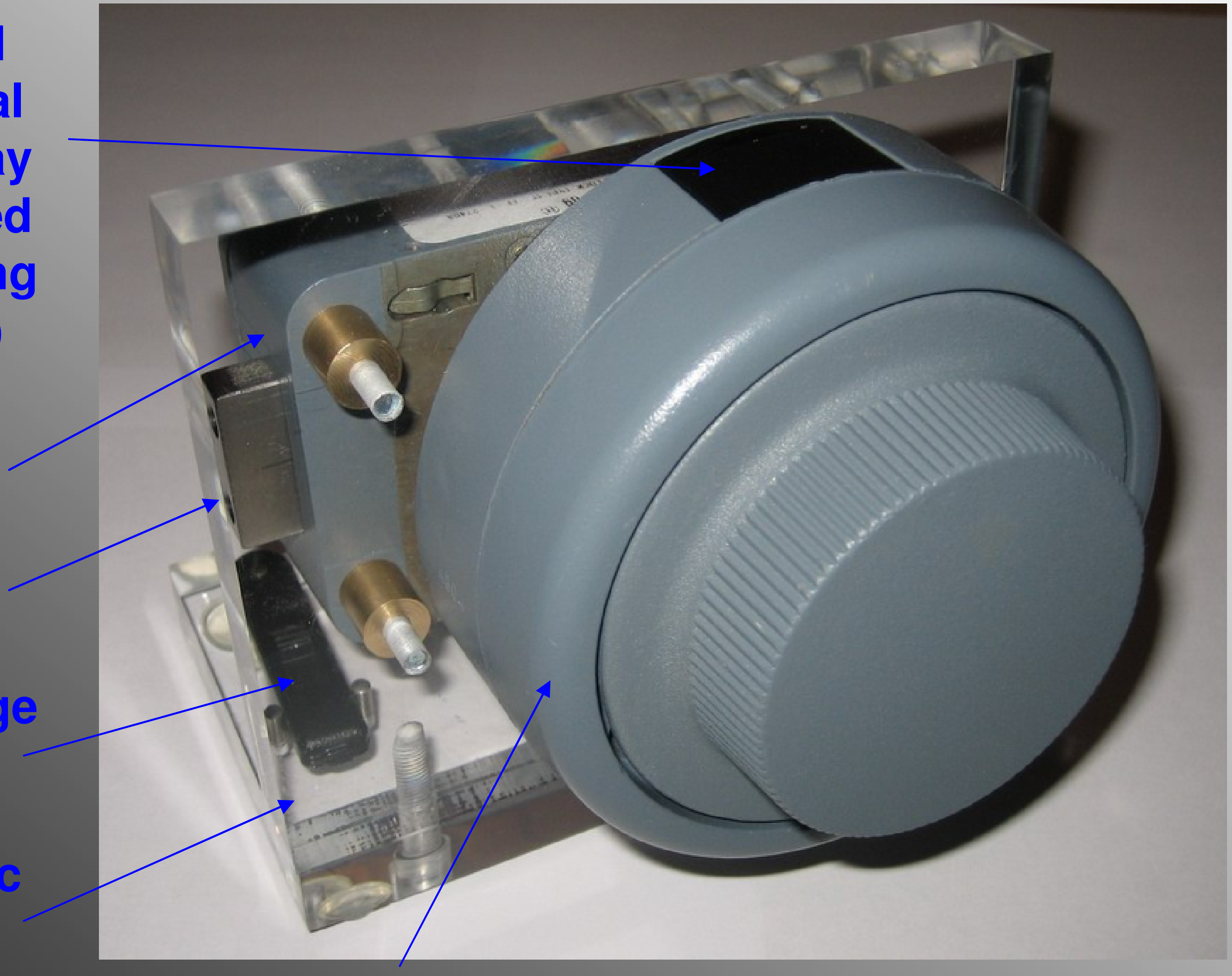
Presentation outline.

- Overview and features.
- Looking inside – why it's secure against bumping and vibration.
  - The motor.
  - The gears / slide / bolt mechanism.
  - A brief look into the other components.
- Why it's secure against a lot of other attacks.
- Links to patents etc.
- Questions.

The KABA MAS X-09™. Overview and features.

- An electronic combination lock for military top-secret containers.
- Self-powered: No batteries required. Turning the dial powers the lock.
- Easy to use: A display shows the combination you are dialing (3 x 2 = 6 digits) and symbols.
- Audit trail: The lock counts the number of openings as well as unsuccessful attempts.
- Dual-responsibility and supervisor-subordinate modes can be configured (two 6-digit combinations required).
- A “lock on back cover” (LOBC) pin tries to keep the lock itself locked up.
- 3rd generation, improved over the original X-07™ and X-08™.

The demo lock.
The main parts and how to use it.



Liquid Crystal Display (limited viewing angle)

Lock case

Bolt

Change key

Acrylic demo stand

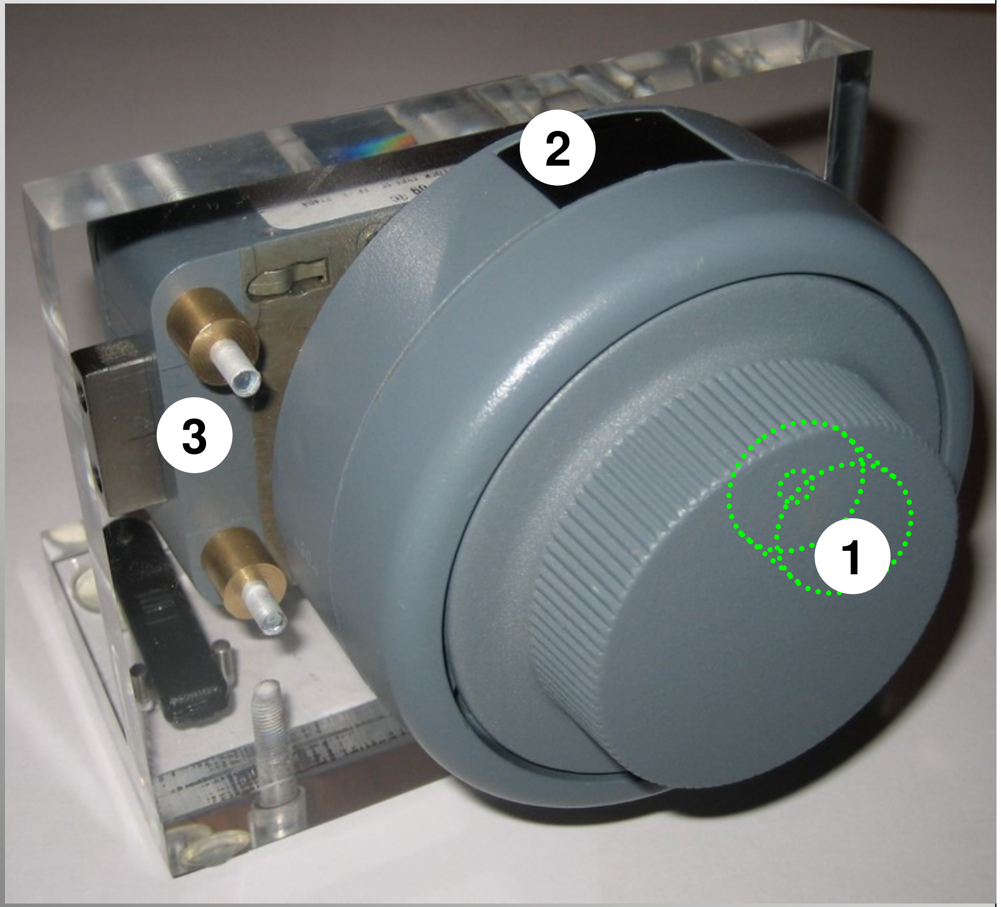
Dial ring

To dial 123456:

- Turn left (power the lock) until you see a (random) value on the display.
- Continue to turn until 12 is shown.
- Turn right to 34.
- Turn left to 56.
- Turn right. “OP” will be displayed and the lock will open.

The general concept.
Basic operation principle.

1. A generator in the dial ring provides electrical energy as well as direction and step signals to a microcontroller in the lock case.
2. The LCD shows the dialed combination.
3. A motor in the lock case couples the bolt mechanism to the dial, and the bolt can be retracted.



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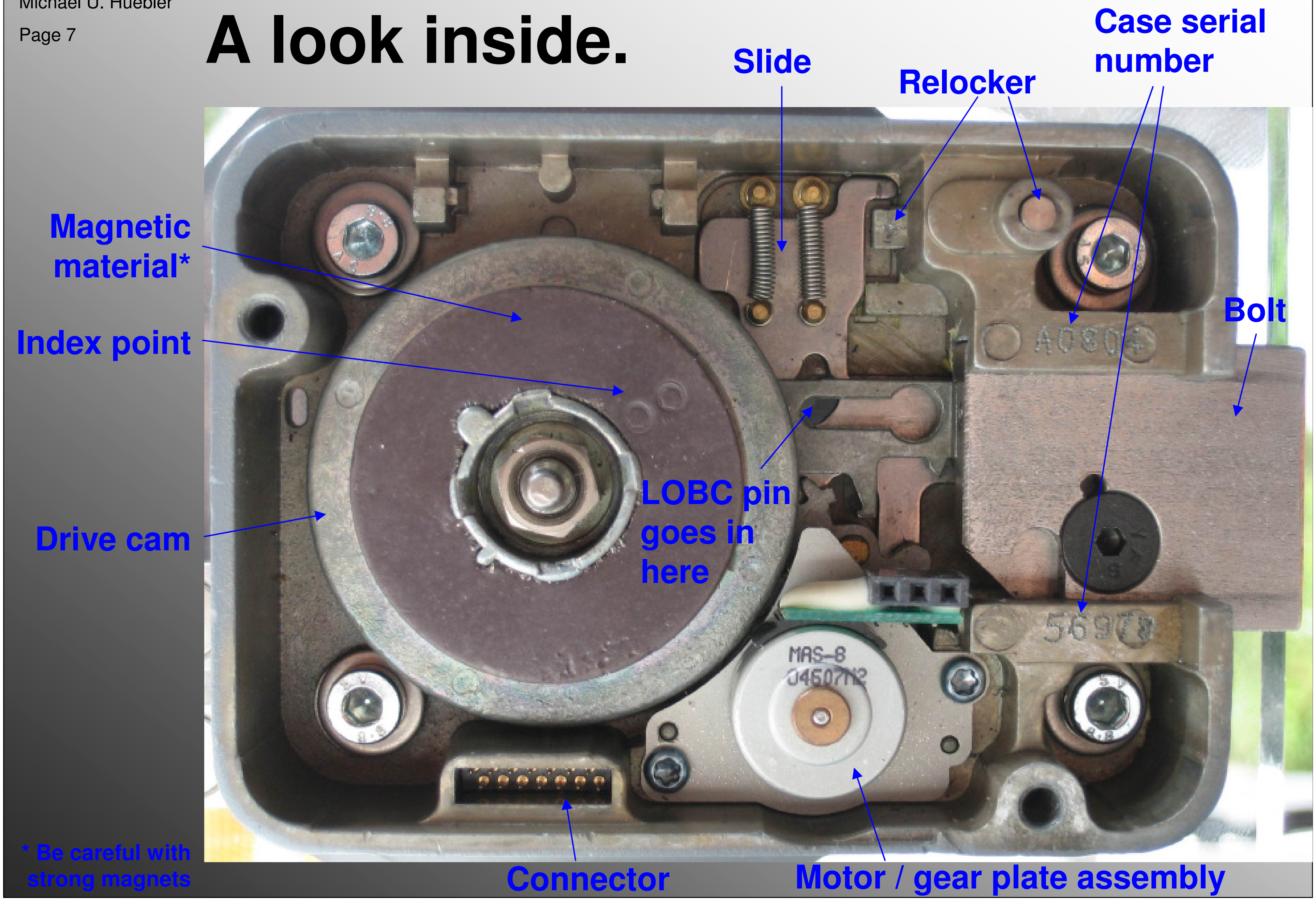
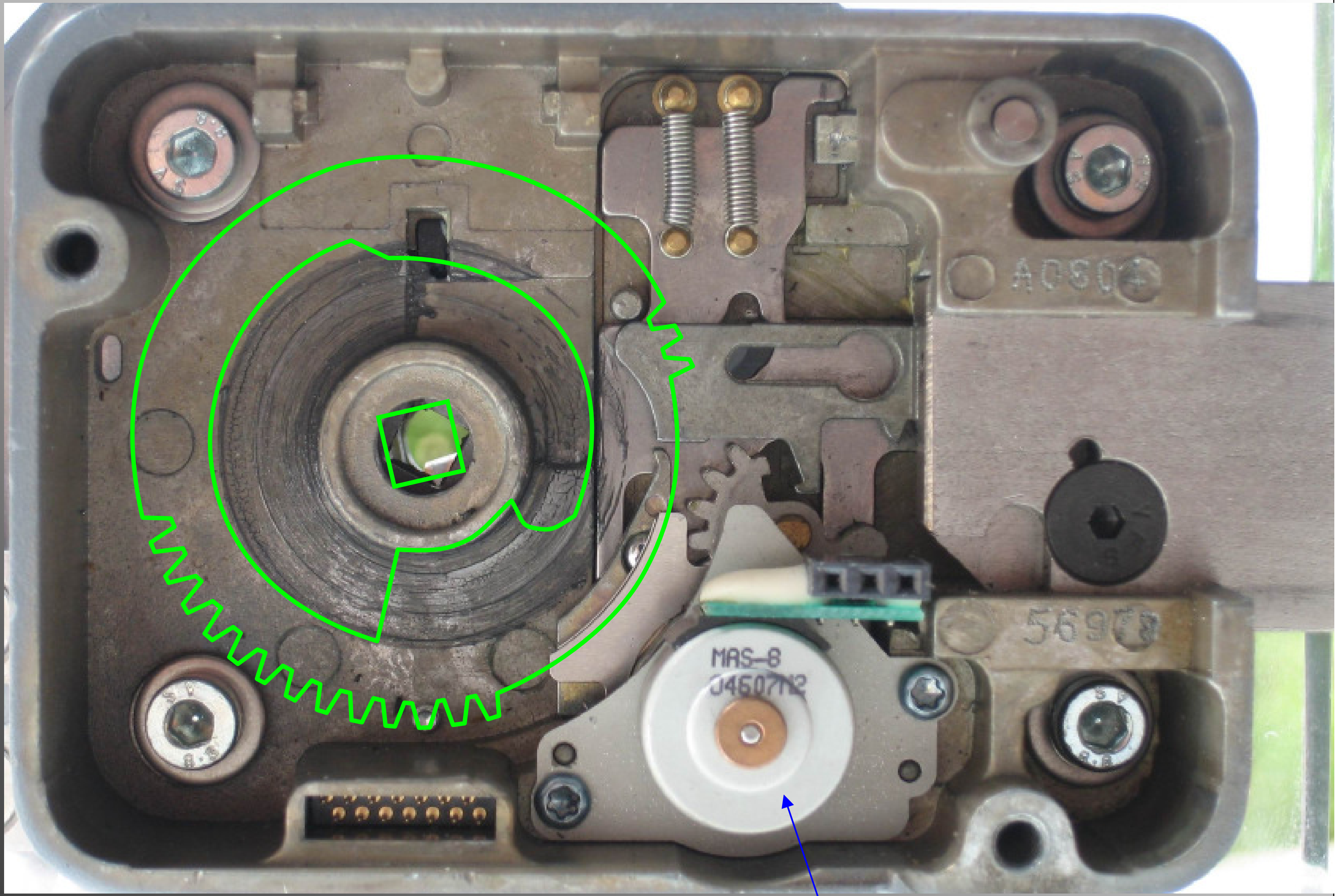
The lock case.
A look inside.



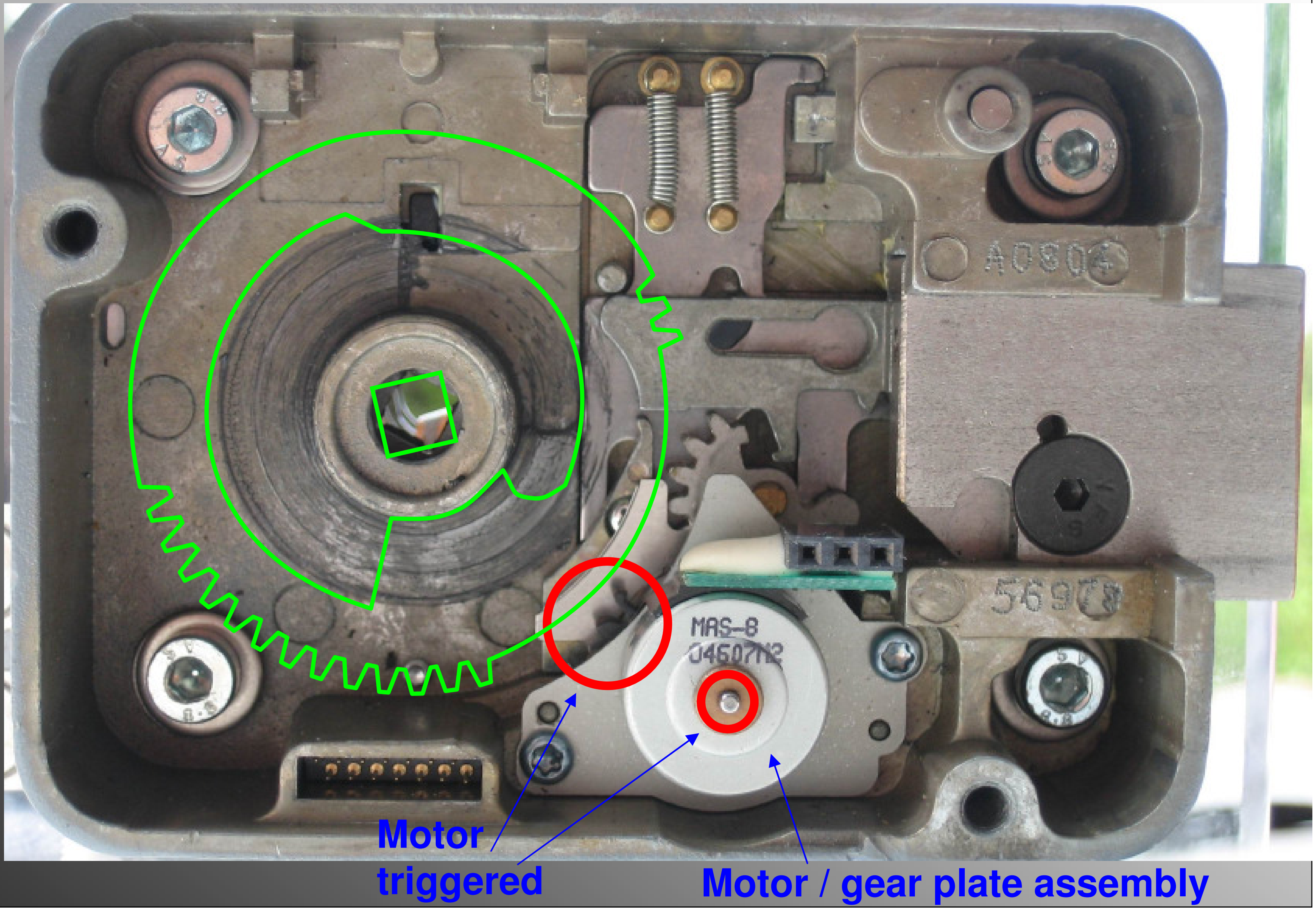
* Be careful with strong magnets

Drive cam removed.

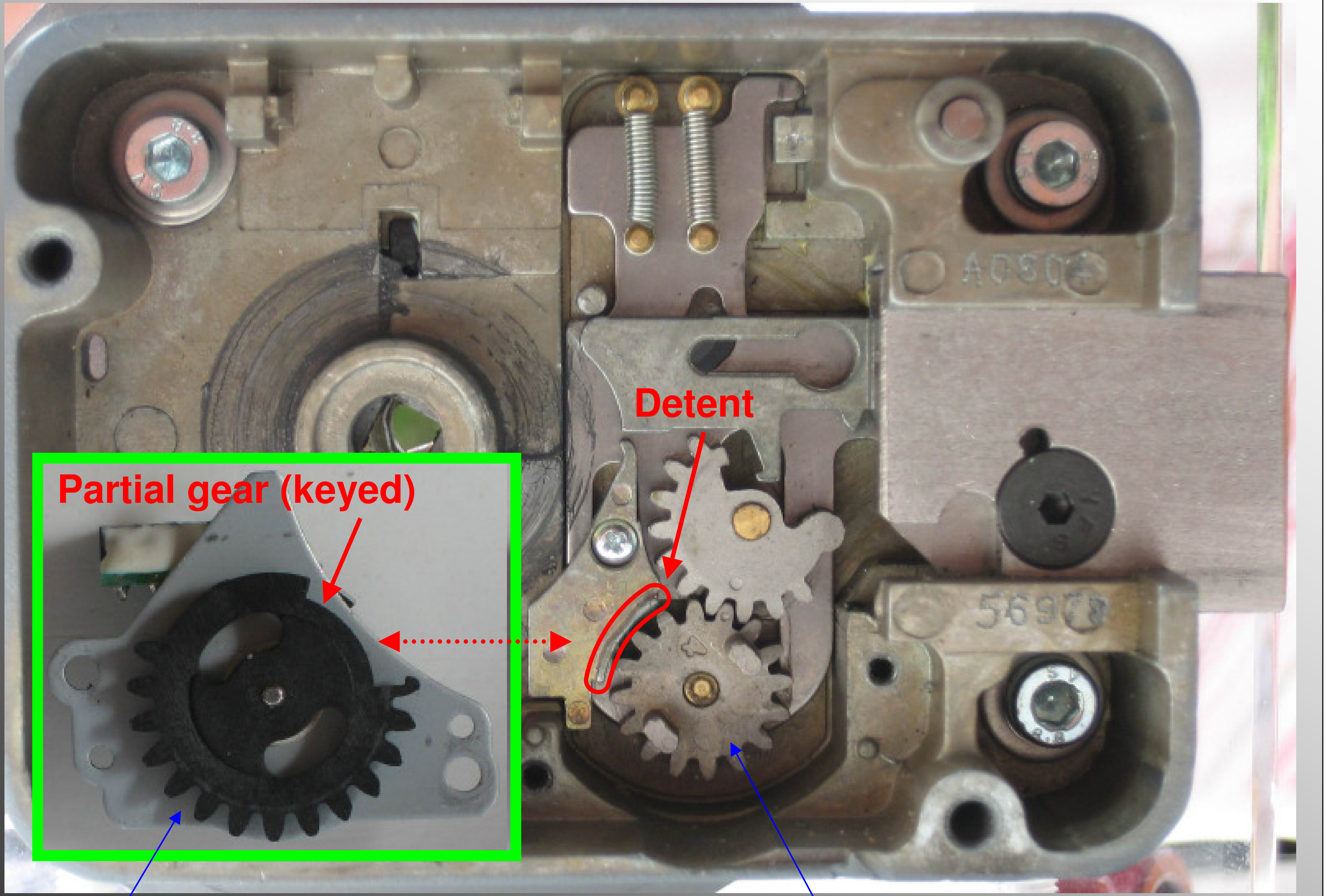


Motor / gear plate assembly

Motor triggered.

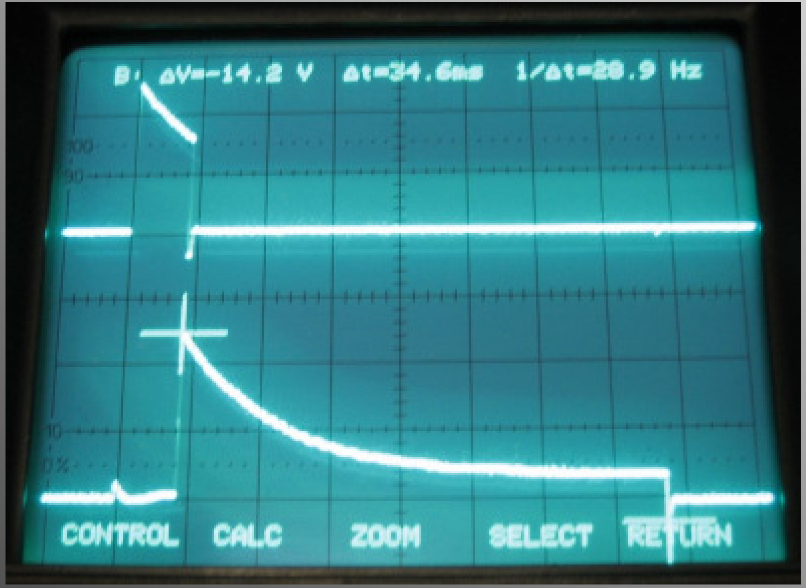


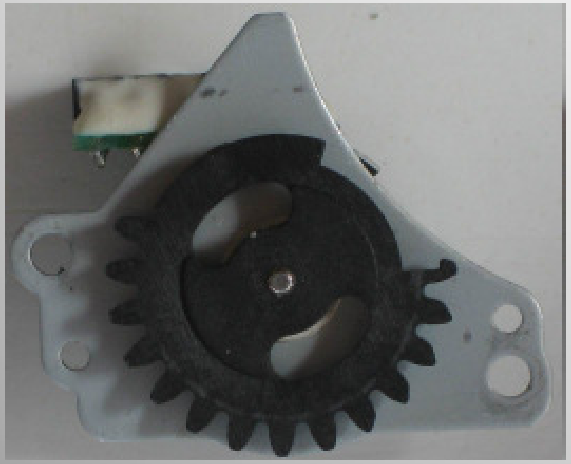
The motor. Secure against bumping and vibration.



The motor. Electrical parameters.

- Patent No. US6731025
- Needs to pull AND turn the gear wheel.
- The motor has 2 electromagnetic coils, the lock generates 2 current pulses to activate them sequentially:





- Powering both coils at the same time also works fine.
→ Motor demonstrator: 9V battery, capacitor, switch that connects the capacitor to either battery (‘charge’) or coils (‘trigger’).

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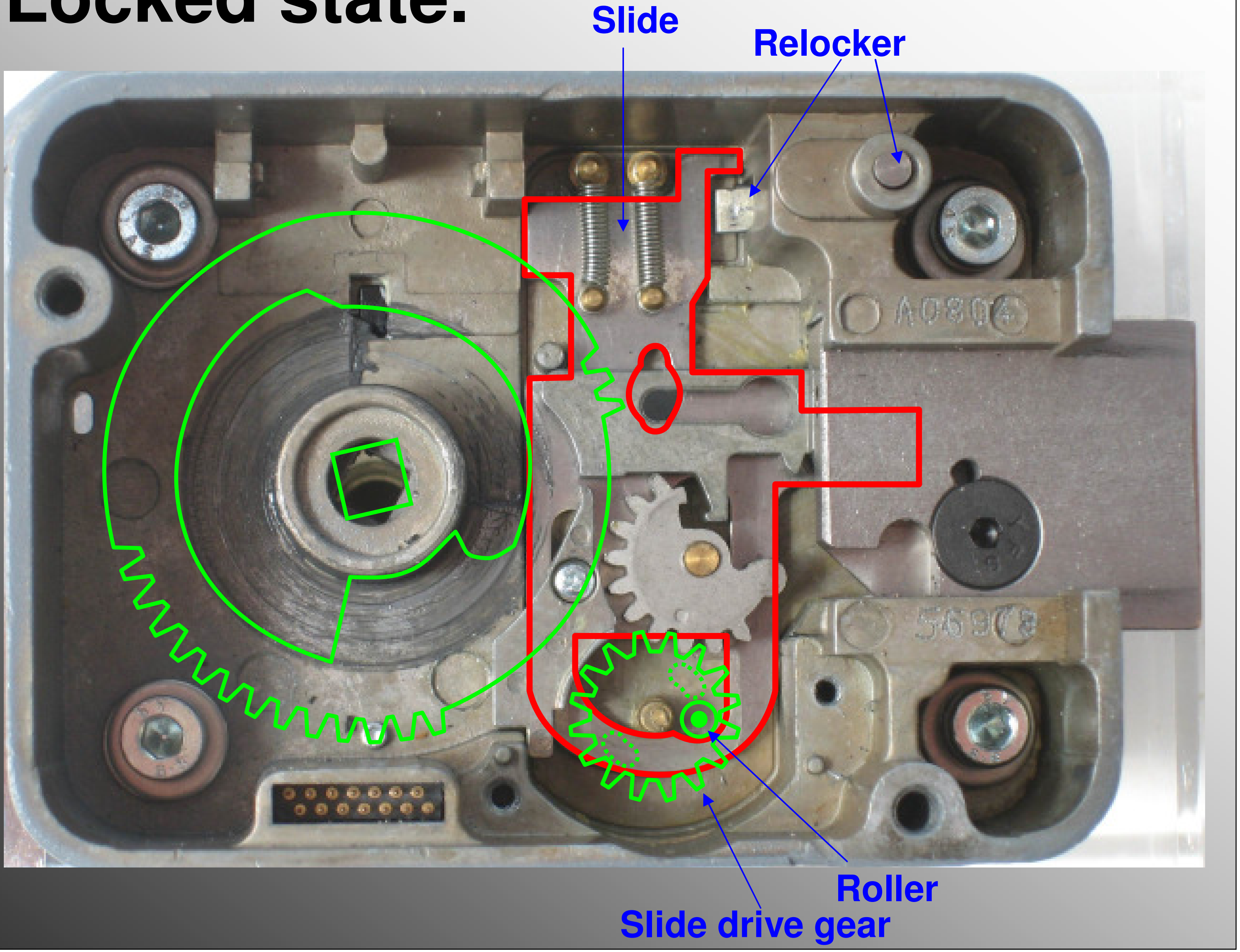
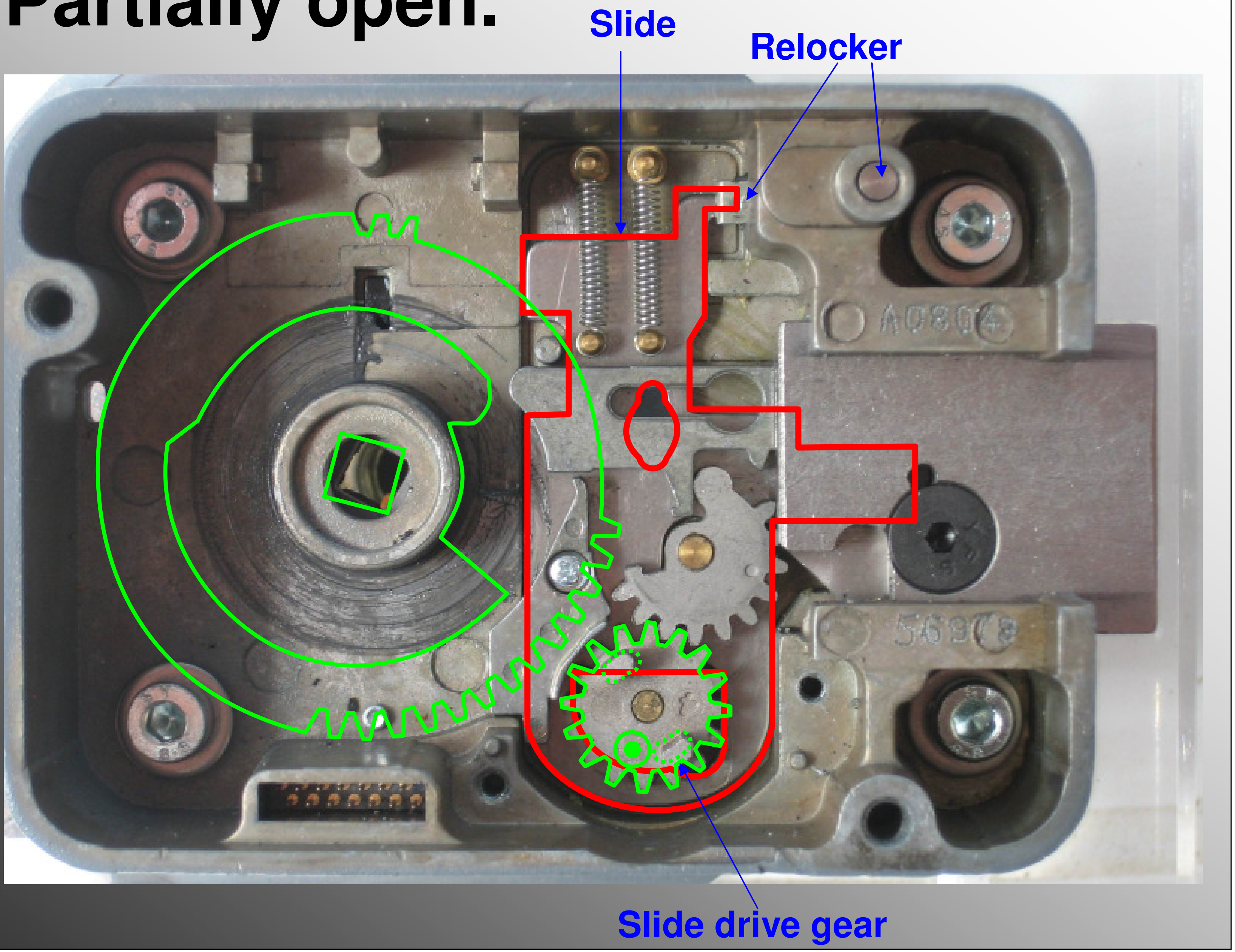
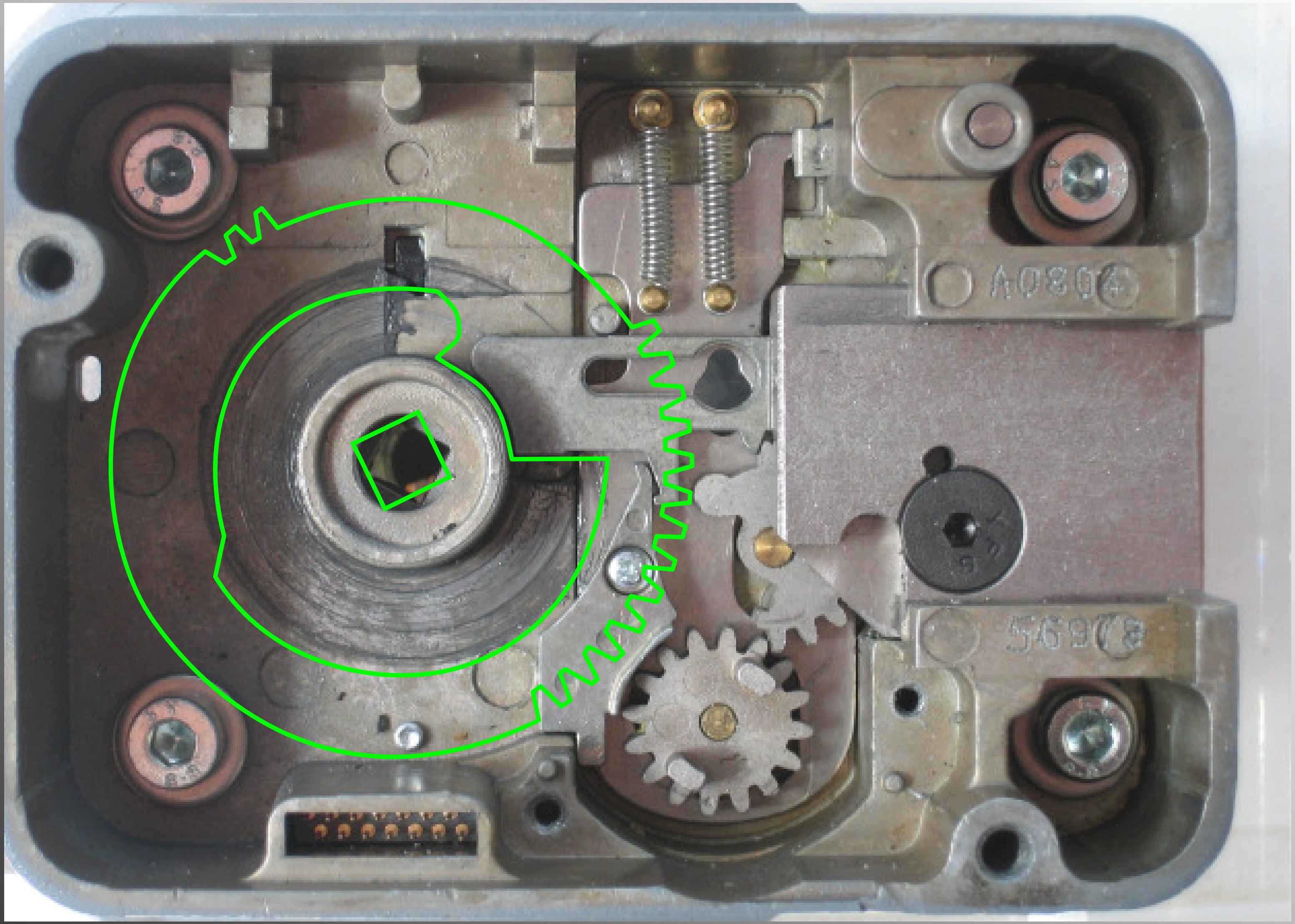
Slide operation.
Locked state.



Slide operation.
Partially open.



Bolt fully retracted.



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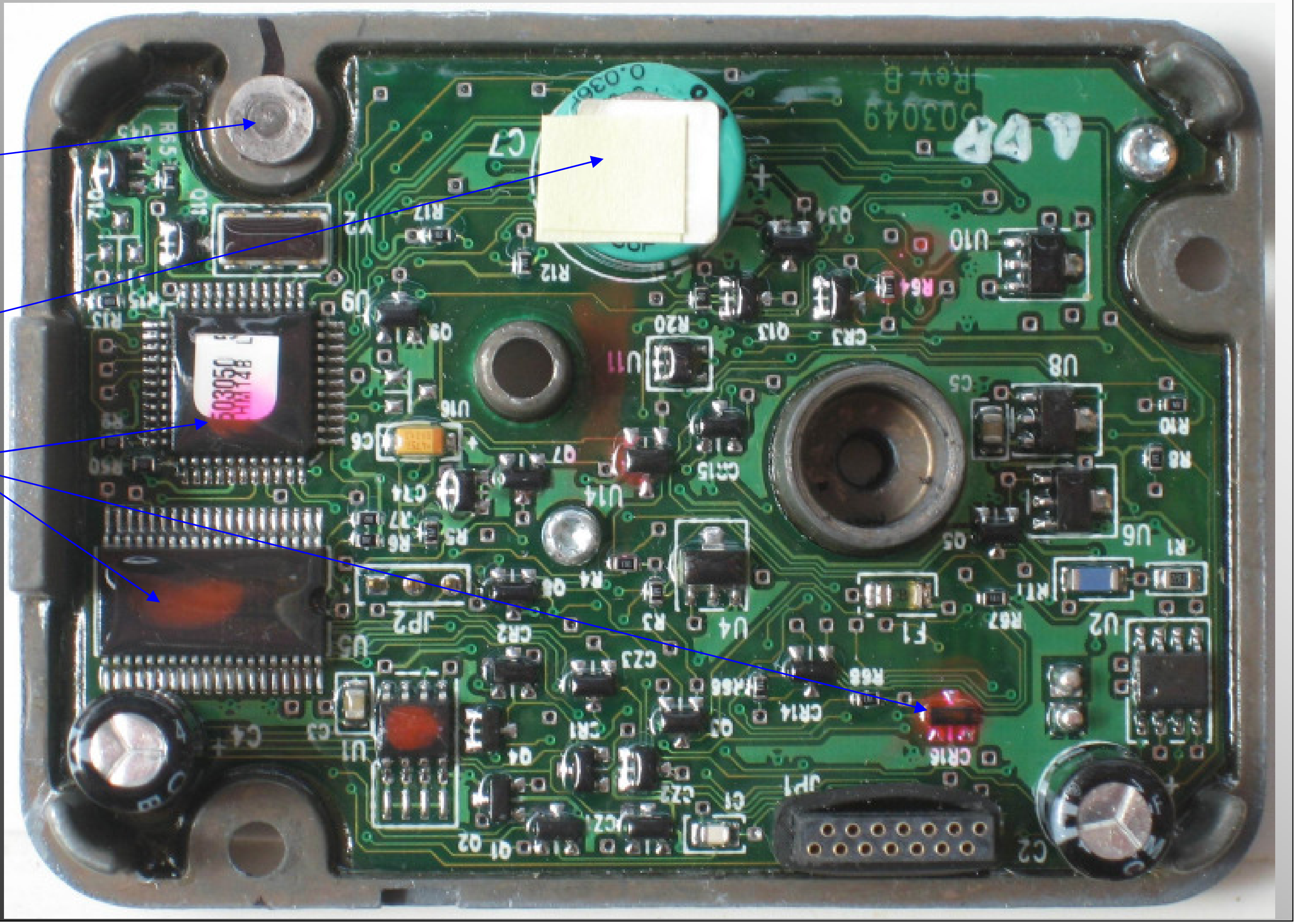
The electronic card (back cover assembly).

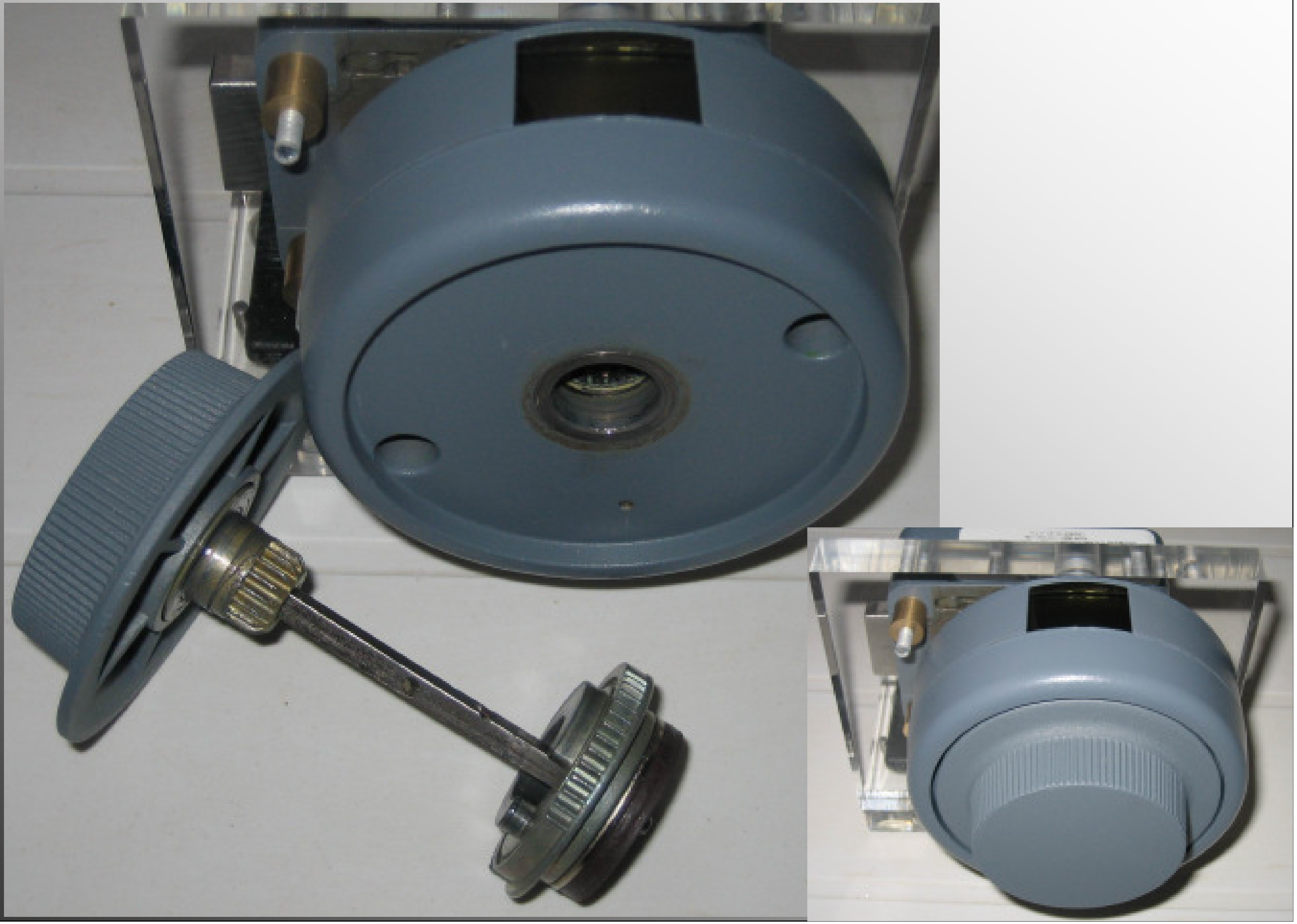


Thermal relocker activator

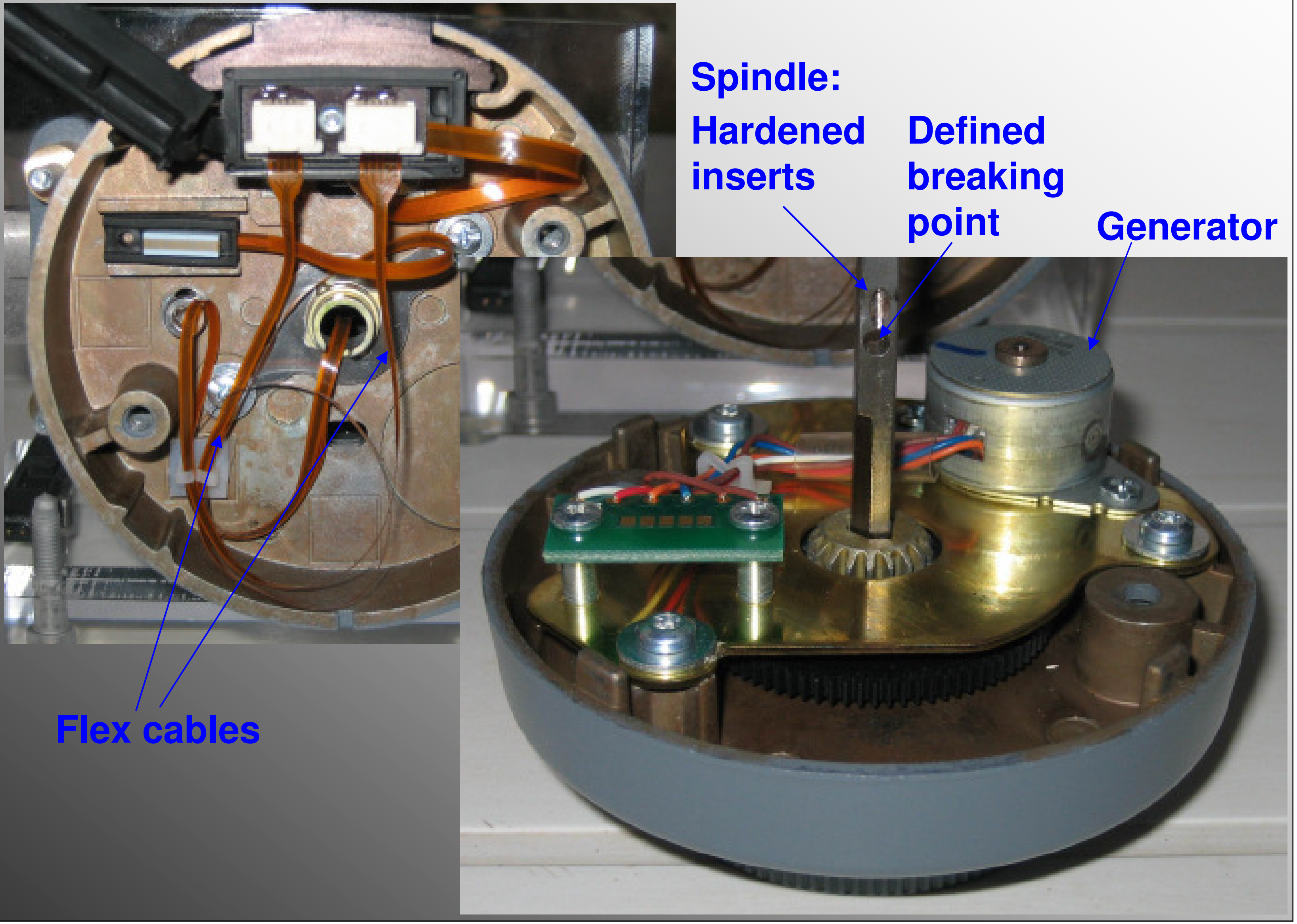
Serial number sticker

UV-active paint

The dial ring.



The dial ring.
A look inside.



Spindle:

Hardened inserts

Defined breaking point

Generator

Flex cables

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Special security features for top secret documents.

Special features have been included to prevent surreptitious opening of the lock, including attempts to extract the combination and replace the lock after a destructive attack, for example:

- The software design tries to prevent reverse engineering / extracting the combinations (e.g. encrypted internal counters and random generator seeds, changing memory locations).
- Maximum dialing speed limit to slow down auto-dialers.
- The electronics board is randomly marked with UV-active paint.
- The connection between the lock body and the dial / LCD assembly seems to be somewhat obfuscated.

Source: LSS+ 5.0 by Marc Weber Tobias, KABA MAS product brochure, FF-L-2740A.

Special security features for top secret documents (continued).

- Meets U.S. Federal Specification FF-L-2740A, e.g.
  Fail secure against high-voltage, vibration, and R/F.

- Audit: Counts all openings (cannot be reset). Counts unsuccessful opening attempts after 3 incorrect combinations.

- Wrong Try Penalty: 10-14 errors results in a 3 minute time out.
  15 errors or greater results in a 4 minute time out.

- Lock on back cover (LOBC) pin prevents removing the back cover without the combination*.

  *Don’t rely on this feature, though.

Source: LSS+ 5.0 by Marc Weber Tobias, KABA MAS product brochure, FF-L-2740A, own investigations.

Further reading.

- Manufacturer’s Website:
  http://www.kaba-mas.com/a.php?page=x-09_main

- U.S. Naval Facilities Engineering Command – DoD Lock Program:
  https://portal.navfac.navy.mil/go/locks (see X-09 “Ordering Info”).
  Has some details on the use of the lock, as well as FF-L-2740A.

- Patents:
  US6741160 (General concept of the X-0x locks)
  US6731025 (Motor)
  US6038897 (Lock on back cover)

Thank you! More questions?

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