Restoration of the Center Lodge Chime - 2023

By Bruce Hall

"*I didn't know this room was here. It's a part of forgotten history*", said our Senior Warden, as we entered the lodge projection room. I was taking him on a tour of the center lodge balcony. We slid past the Allen Organ and opened a door to a small dark room. One would hardly know the room existed, except for two small, paneless window openings that look out onto the lodge room below.

Those wall openings allow a projectionist to shine slides across center lodge onto the wall-mounted screen in the north-east corner. The slide projector was undoubtedly used for years as a visual aid for the masonic degree lectures. It still contains a carousel full of slides. The projector was made obsolete by the cart-mounted TV screen and DVD player, which do not require anyone in the balcony. Months earlier, the Senior Warden asked me where he could obtain degree lecture slides. Neither of us knew that slides had been in lodge the entire time.

On one wall of the projection room hangs a tall, rectangular wooden box, open to the front, covered by heavy green fabric. Pulling the fabric aside reveals a felt-linted cavity, and a long, metal tube that is suspended from the top of the box. The box contains an ringer which strikes the top of the tube when electricity is applied. A wire connects the ringer with a smaller wooden box below.

Center Lodge Balcony: original 1927 chime box

The Batteries

Battery supply for the lodge chime

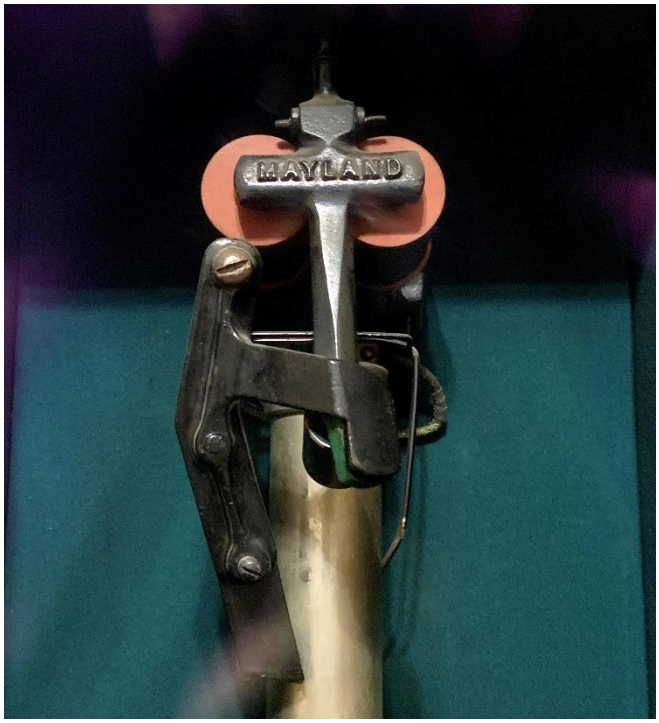
The small box appears to contain a battery to power the chime. The first question to answer is: what battery does it use? Can we still buy the same battery? The "battery box" is tightly secured to the base of the chime, making it difficult to open. However, batteries used for a similar chime box in an adjacent lodge room were Eveready #6 ignitor dry cells. These six batteries were wired in series to produce an output of 6 x 1.5 = 9 volts.

Eveready #6 dry cells have an interesting history. This battery, 2 ½" x 6" in size, has a zinc casing connected to the outer thumbscrew (-) and a carbon rod connected to the center thumbscrew (+). The #6 dry cell was very common throughout the 1940's and 1950's, and manufactured until the 1980's. The modern alkaline equivalent, called the ALR40, is specialty battery that consists of two "F" cells, connected in parallel. An example is the Excell EBR50, available on Amazon for $50 each.

(An interested aside: today's 6V lantern battery contains four "F" cells wired in series. 4 x 1.5 volts = 6 volts.)

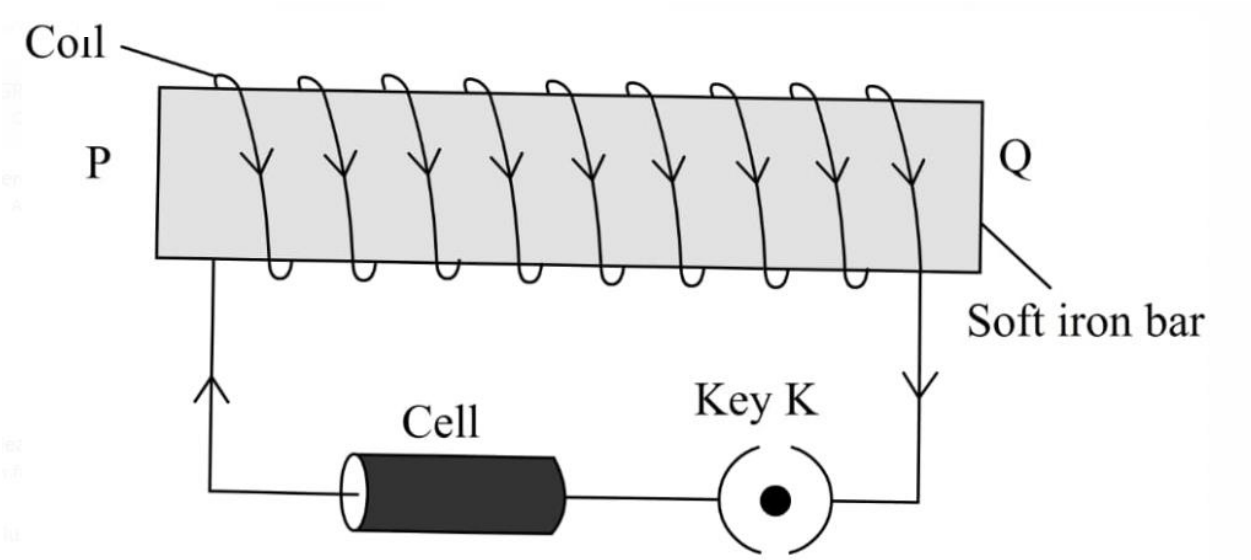
How a Chime works

A chime works by striking a hollow metal tube. The vibration frequency f(Hz) = k / length^2, where the constant k depends on the material properties. The tube is struck by a metal arm suspended over an electromagnet. When the electromagnet's coil is energized by an electrical current, the base of the arm is pulled toward the magnet, causing the end of the arm to strike the tube and create the sound. The electromechanical heart of our Center lodge chime was manufactured by Rowland Hill Mayland, a distinguished chime manufacturer from Erie PA. Mayland chimes are highly collectable and known for their beautiful sound.



The Mayland Chime electromagnet and striker

The Center Lodge chime, as found in January 2023, was inoperable. The batteries, dating from the 1960's or early 1970's, had long ceased functioning. The wiring showed evidence of rework and was incomplete. But the chime itself seemed mechanically intact. I presented my research to Millennium Lodge #779 on 2/27/23 and asked the lodge to fund a chime restoration project. They agreed.



The basic circuit of a chime consists of an electromagnetic coil, a battery cell, and a key or switch. The switch completes the circuit and causes current to flow, which magnetizes the coil

and pulls the striker bar against the chime tube. When the switch is released, the magnetic field collapses and the striker returns to its neutral position.

Ohm's Law

We know that the original battery supplied 9 volts. But how much current is flowing in this circuit? Since these batteries are no longer manufactured, we must calculate the size of the power supply required. The relationship between voltage and current is specified by Ohm's Law: Current = Voltage / Resistance. In other words, we determine the current requirement of our electromagnet at a given voltage by measuring the resistance across it. Using a multimeter, I measured the coil resistance as 8 ohms. By Ohm's Law, the current flowing through this coil at 9 volts = 9 volts / 8 ohms = 1.13 amperes. And the power dissipated by this coil is the product of voltage and amperage = 9V x 1.13A = 10 watts.

After characterizing the electrical properties of the electromagnetic coil, it was time to see if it still chimed. I briefly connected an adjustable power supply to the coil and… it rang! At 9 volts the chime was moderately loud. I tested the chime with voltages as high as 12 volts (1.5A, 18W) and low as 5 volts (0.63A, 3W). The 12-volt supply resulted in a very hard strike and heated the electromagnet unnecessarily.

Replacing the Battery

In the 1950's, six #6 dry cells were an inexpensive purchase from any local hardware store. But in 2023, it is $300 online expense. Since we need 9 volts, one might be tempted to try a modern, rectangular "PP3" 9-volt battery. It will not work. This small battery cannot supply enough current to energize the coil and move the striker arm. A much better choice would be a DC power adapter. A 9V adapter connects to an AC outlet and provides 9V direct current. Our chime requires 1.13 amps. Most adapters supply 1 amp or less, but larger adapters supplying 2 amps are not difficult to find. I tested a 9V/2A DC power adapter with the chime, and it worked great. At a cost of $20, a DC power adapter is much less expensive - and significantly more convenient - than replacing batteries.

Doorbells and Garage Door Openers

This project requires a normally open (NO) pushbutton switch. Press the switch to ring the chime. While there are hundreds of different styles that would work, I chose the simplest and cheapest: a doorbell. It seemed to me that a doorbell switch and a chime naturally go together. I connected the chime to a doorbell and 9V/2A DC power adapter, plugged it in, and… it worked. At this point I was satisfied that the project would be successful.

I was bothered, however, that our chime still required an operator in the projection room. It was inconvenient at best. How could the "chime-ist" return to the tyled lodge room? Would he be forced to remain there for the rest of the degree? Would it be possible to move to switch to a more convenient location – somewhere inside the lodge room? And how would the wires be routed?

My solution wasn't available in the 1920s. Don't use wires at all. Go *wireless*. And as I thought about wireless solutions, the simplest and most reliable method I found was – a garage door opener. A garage door opener does not require line of sight, like the typical TV remote. It can operate through walls. And the remotes, powered by coin cell batteries, can be very small indeed. This handheld remote is used activate the chime from within the lodge room.

I scoured the internet for garage door openers. I found many varieties. Unfortunately, very few of these devices are rated to work with a 9-volt supply. Most openers use 12 volts to 24 volts. It felt it important to use a widely-available device, should it need to be replaced in the future. My options were either to purchase a second DC Power adapter, just to power the 12-volt receiver, or adjust the entire circuit to work with a single 12-volt power supply. For simplicity and economy, I chose the latter.

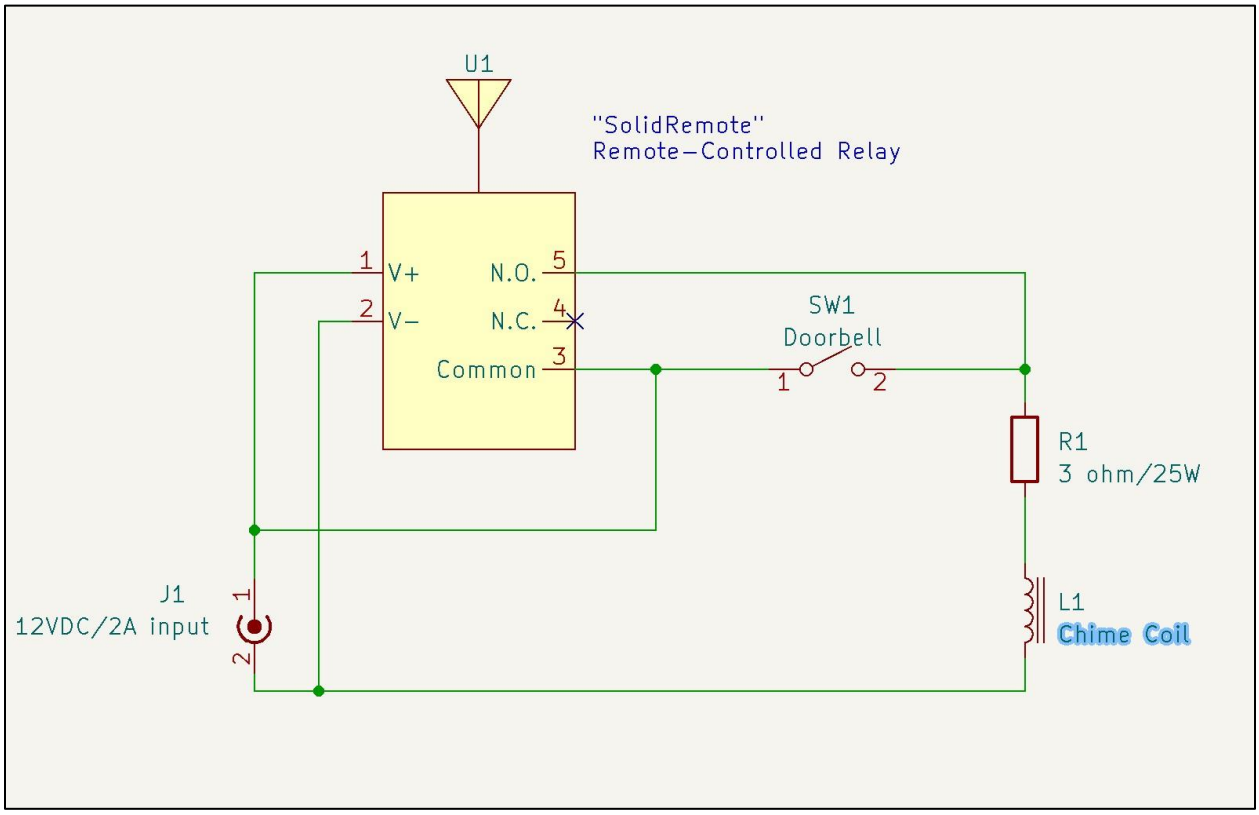
Using a single supply

Testing had shown that the chime would work with 12-volts directly, at a cost of unnecessary power dissipation in the coil. This heating could significantly shorten the coil's life. The voltage should be reduced, ideally to the 9-volts used in the original circuit. Several methods were considered, including voltage regulators and diode drops, but the simplest method is a series power resistor.

Consider a power resistor in series with the electromagnetic coil. The resistance of the coil is 8 ohms, and the resistor is *X* ohms. The circuit load is the sum of the resistances, or 8 + X. To maintain the 1.13 amps of current as in the original circuit, we use Ohm's Law again to solve. Voltage = Current x Resistance. 12 volts = 1.13 * (8 + X) = 9.04 + 1.13X. Rearranging algebraically: 12 – 9.04 = 1.13X, or X = 2.96 / 1.13 = 2.26 ohms. A 2.3-ohm resistor will result in the desired current. Rounding up to 3 ohms reduces the current slightly and results in a more-easily obtained part. With a 3-ohm resistor, the circuit current is 12V/11R = 1.09A. The voltage drop across the coil is I*R = (1.09A) x (8 ohms) = 8.7 volts. The power dissipated by the coil is 8.7V x 1.09A = 9.5 watts. These values nearly equal to those observed with the original 9-volt supply. The resistor dissipates (1.09)(1.09)(3) = 3.6 watts, so a 5 watt power resistor will suffice.

Circuit Schematic

Here is the schematic for the revised chime circuit, including a single 12VDC supply, a garage door opener, and a power resistor:



At the lower left, a barrel jack is used to connect the DC power adapter to the rest of the circuit. This jack serves two purposes: first, it allows the adapter to be easily replaced. Most 12V adapters are terminated with compatible 1.2mm DC plugs. It also serves as a decoupling or breakaway point. If the power cord were forcefully pulled away from the chime, it would disconnect at the jack before damaging the circuit, like a breakaway hose at the gas station.

The garage door receiver is the yellow symbol U1 in the middle of the schematic. It serves as a remote-controlled switch, momentarily applying power to the chime whenever the remote button is pressed. A doorbell switch is placed in parallel with the remote unit, so that the chime can be activated locally without the remote. The two pins on the left supply power to the unit. The three pins on the right represent the common, normally-open, and normally-closed terminals of the internal relay. The pin labelled “common” is connected to 12-volt DC. When the remote button is pressed, the common pin connects to the normally-open “NO” pin, allowing current to flow into the chime.

The right side of the schematic represents is the load, consisting of the power resistor and chime coil.

There are many suitable choices for a remote control. I chose the SolidRemote SR-RCS-202U receiver and matching TX134 control for the following reasons:

a. It can be powered by 12 VDC.
b. The remotes are FCC certified.
c. The remotes batteries are common (CR2032).
d. It can easily handle an inductive load of 2A at 12V (Rated 6A at 14V).
e. The remotes can be purchased separately.

Adding a Power Indicator

The circuit was installed on 16 Mar 2023. It worked flawlessly, but it was difficult to tell if the unit was powered or not. So, I decided to add an LED power indicator.

LEDs require roughly 2 volts and 5-20 mA to operate. Connecting a LED directly to 12-volt supply will instantaneously burn it out. It must be used with a series current-limiting resistor. Ohm's Law is used to calculate the resistor's value. To obtain a 2-volt drop across the LED, the voltage drop across the resistor must be 12 – 2 = 10 volts. Its resistance is calculated as voltage/current = 10V / 5 mA = 2 K-ohms. The closest standard value is 2.2K. This small LED circuit was tested and found to provide an easily visible power indicator.

The Mystery Box

A few things didn't make any sense. First, the "battery box" seemed too small to contain all six batteries. Second, it was tightly secured, which would have made battery replacement difficult. And third, what was the function of the "Pull out then release" ring? After finishing the chime restoration, I decided to investigate.

The box cover is held in place by 12 wood screws. The interior of the box is padded on all six sides to lessen any sound produced by the mechanism inside.

The mechanism is a squat 6" black metal cylinder, with a brass lever on the front. Large letters embossed on the front of the device say, "Pull Lever Way Down Let go".

The mystery box, removed from its wall mount.

This is no battery. But what is it?

I pulled the ring on the outside of the box, which in turn pulled down the brass lever. And I listened. The device sounded like a mechanical watch, or more accurately, like a wind-up kitchen timer or toaster oven control. And periodically it would emit a click. I counted the clicks. Each pull of the lever resulted in exactly 12 clicks, spaced a few seconds apart.

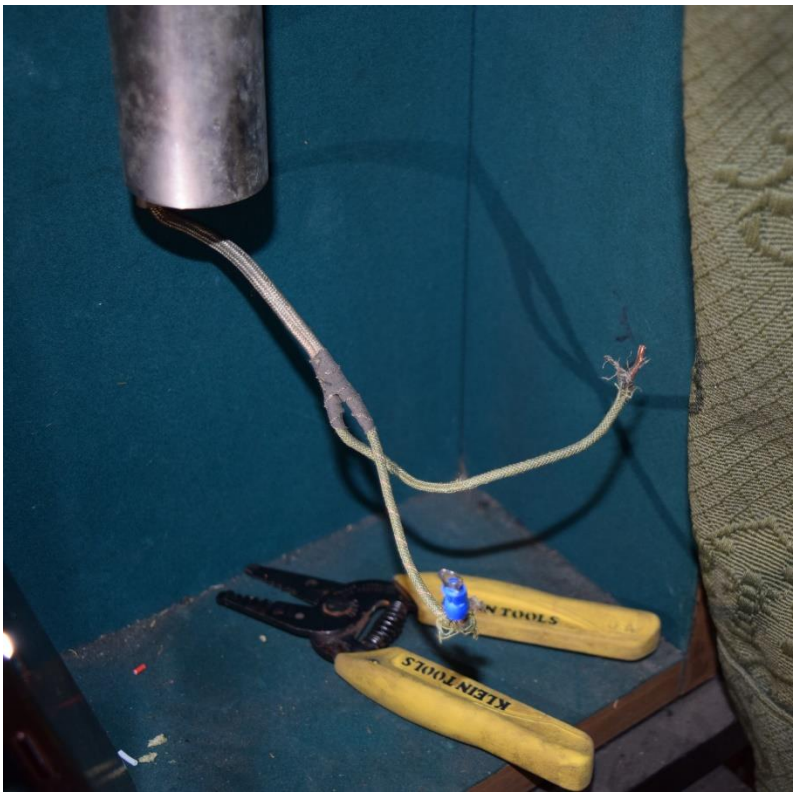
Could this device be a fancy timer switch, producing 12 rings of the chime?

There was only one way to find out. I connected the terminal posts on the side of the box to the doorbell terminals and et voilà, the chime rang 12 times. I decided to keep it connected to the chime.

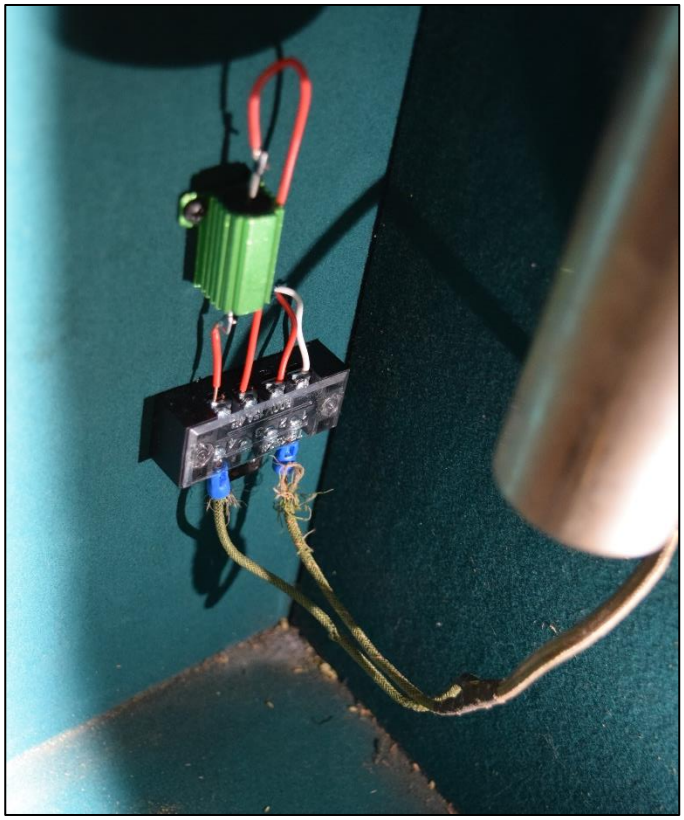
It's been many, many years since the chime last rang in lodge. I have not yet met anyone who remembers it. The center lodge chime will proudly ring again as we raise Master Masons in Millennium Lodge #779.

Construction Progress

This is the original wiring, showing the bottom of chime and the “mystery box” (see text).



The old battery wiring was removed, and new connectors were added to the chime wires.

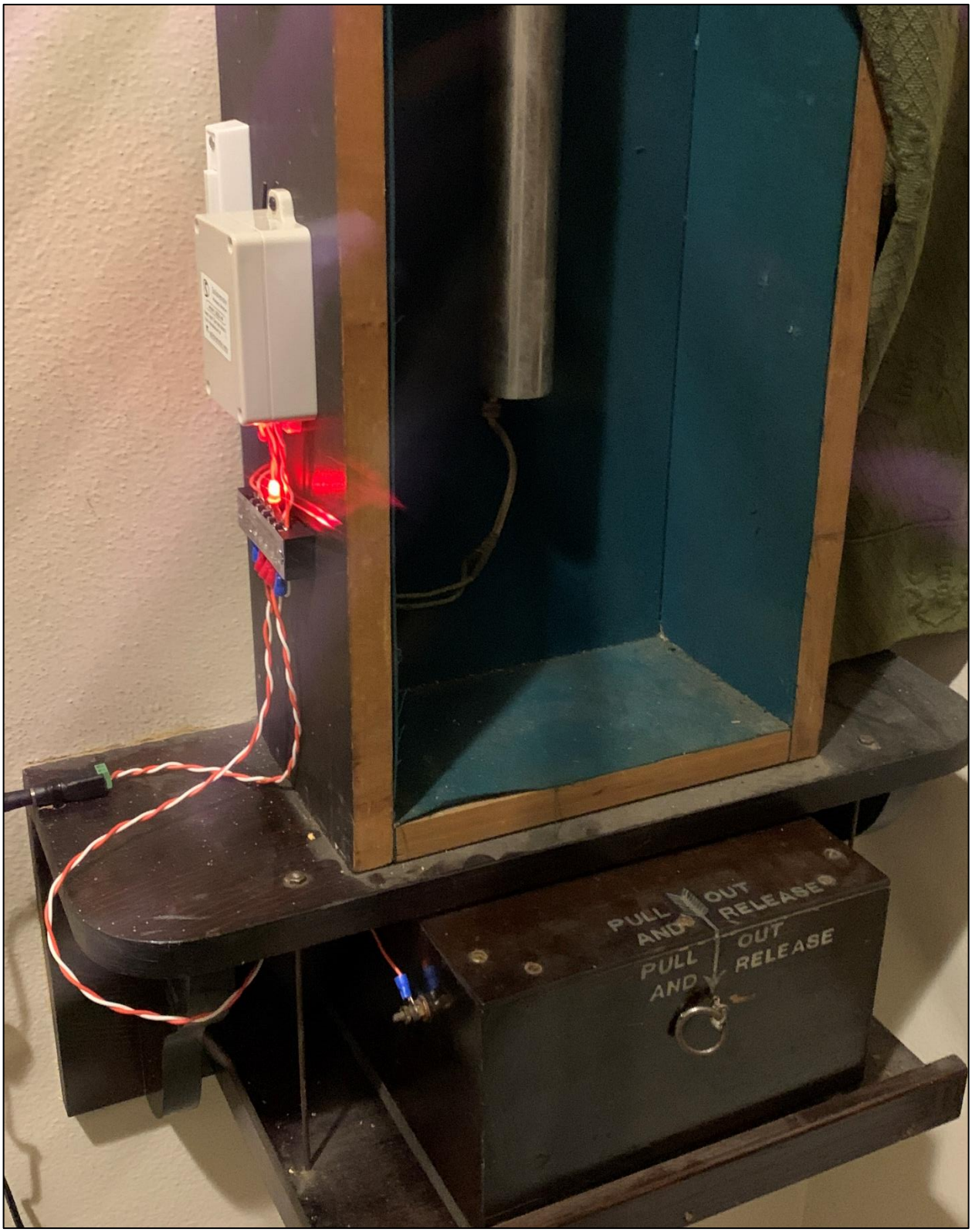


A barrier strip was mounted inside the box, attaching the original chime wiring to a 3-ohm, 25-watt power resistor (green).

A doorbell pushbutton was added outside the box to activate the chime.

The larger rectangular box is a garage door receiver, used to control the chime from inside the lodge room.

Final appearance, after reconnecting the original timer switch.



APPENDIX

How to operate the chimes:

1. Make sure that the chime system is plugged in. The red LED indicates power is on.
2. Test the unit by pressing the 'A' button on the remote control. The chime should ring. Also, the pinhole LED indicator on the remote should illuminate when you press a key. If it doesn't, the remote's CR2032 battery needs to be replaced.
3. You can manually test the chime by pressing the doorbell on the side of the chime box. Alternatively, "pull the ring" to ring the chime 12 times.

Programming the Remote Control:

1. Remove four corner screws on the Solidremote receiver and lift off top cover.
2. Confirm that all 4 DIP switches on the red switch block are in the OFF position. This puts both relays in the Pulse (Momentary) mode.
3. Apply power and confirm the power LED is lit. If not, check power.
4. Press and hold the two black programming buttons until the Signal LED is on. Release buttons.
5. Press the button on the remote and hold until the Signal LED flashes, then release.
6. Press the remote-control button again to confirm that it operates the relay.
7. Repeat steps #4 - #6 for any remote control that you want to use.
8. Replace top cover and four corner screws.

Deleting all stored transmitter Codes:

1. Remove four corner screws on the Solidremote receiver and lift off top cover.
2. Turn off power to the receiver and confirm the power LED is OFF.
3. Press and hold down both black programming pushbuttons.
4. While still holding down the buttons, turn the power ON.
5. After 5 seconds, SIG LED will illuminate to indicate that the memory is cleared.
6. Release the programming buttons.
7. Confirm that the none of the transmitters can operate the device.
8. Reprogram as above, if needed.
9. Replace top cover and four corner screws.

Purchasing links for the remote receiver and transmitter:

Remote Control Switch by Solidremote Technologies (Description only)
Solidremote Receiver - Amazon.com
Solidremote Remotes, 2 Pack - Amazon.com
Keyfob 4-Button Waterproof RF Remote Control | Solidremote Technologies
Keyfob 2-Button Waterproof RF Remote Control | Solidremote Technologies

TROUBLESHOOTING

What to do when the chime doesn't ring:

1. Press and hold any button on the remote. Does the pinhole LED illuminate? If not, replace CR2032 battery inside the remote.
2. Go up to the projection room and check the power LED on the side of the chime box. If it is not illuminated, the power is out: check the power cord, make sure the AC adapter is plugged in, and all connections are secure.
3. Assuming the power LED is on, press the doorbell. Does the chime sound? If so, the remote unit (either the receiver or transmitter) is faulty. Replace the transmitter battery. Reprogram the receiver, if necessary, as described in the appendix. If the chime doesn't sound, check all wiring connections going to the chime.

WIRING DIAGRAM