

SWCC Repair Tips 2: Overhaul and Motor Adjustments

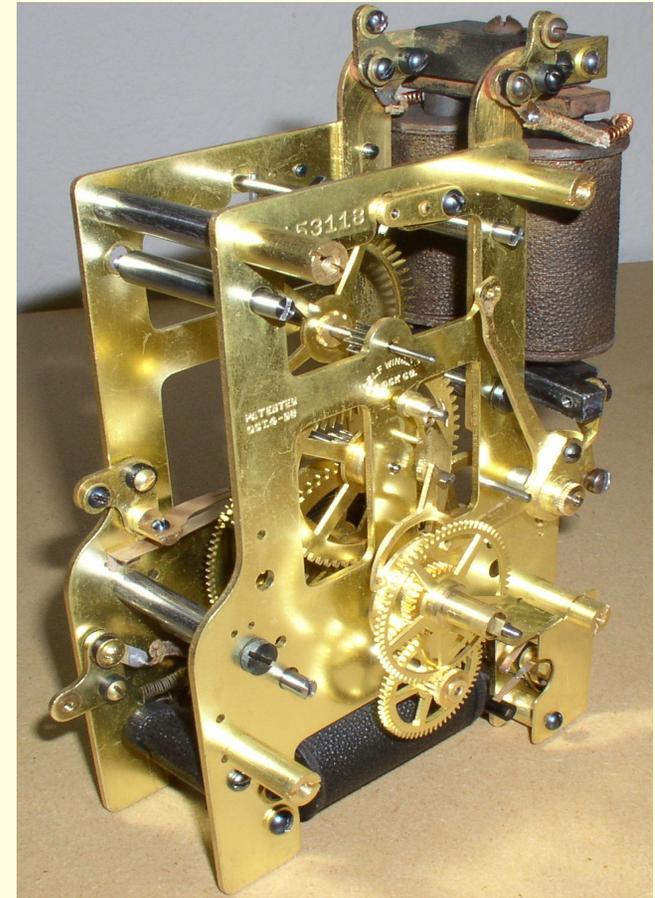
Style F Self Winding Clocks



Ken Reindel
NAWCC Chapter 21
September 28, 2020

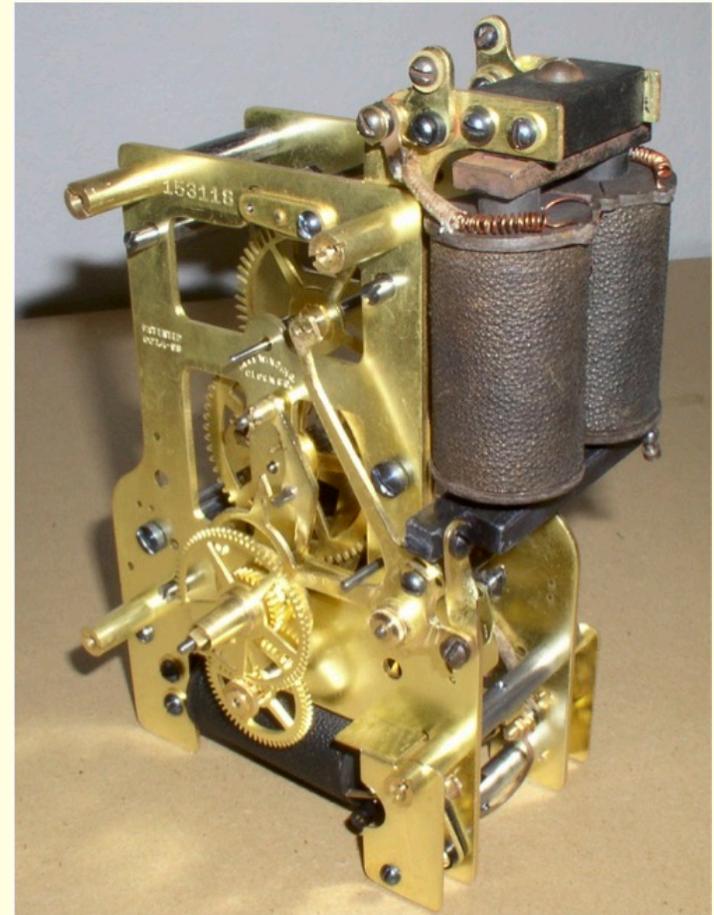
Agenda

- Organizing Style F Overhaul
- Movement Cleaning
- Repairing Key Mechanical Parts
- Contacts
 - Replacing Platinum
- Repairing Coils
- Damping Resistor
- Reassembly and Adjustments



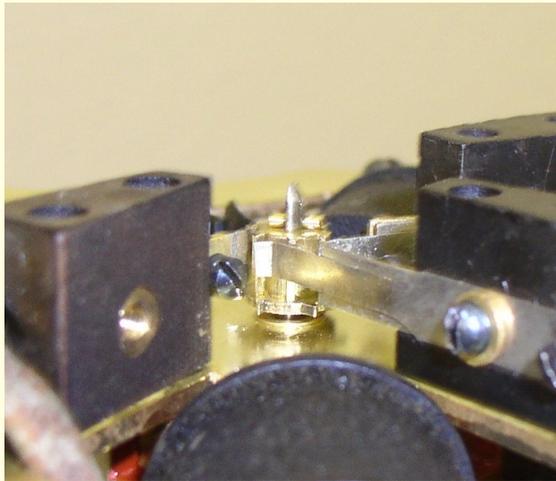
Additional Topics

- Electricity Basics Review
- Right and Wrong Power
- Restoring Coil Cover material
- Graham Dead Beat Escapement Adjustment



What we will NOT Cover

- Details on Style A, B and C Restoration
 - Topic for Advanced Class
- Synchronizer Repairs and Adjustments
 - Topic for potential follow up class
- Details on all parts fabrication



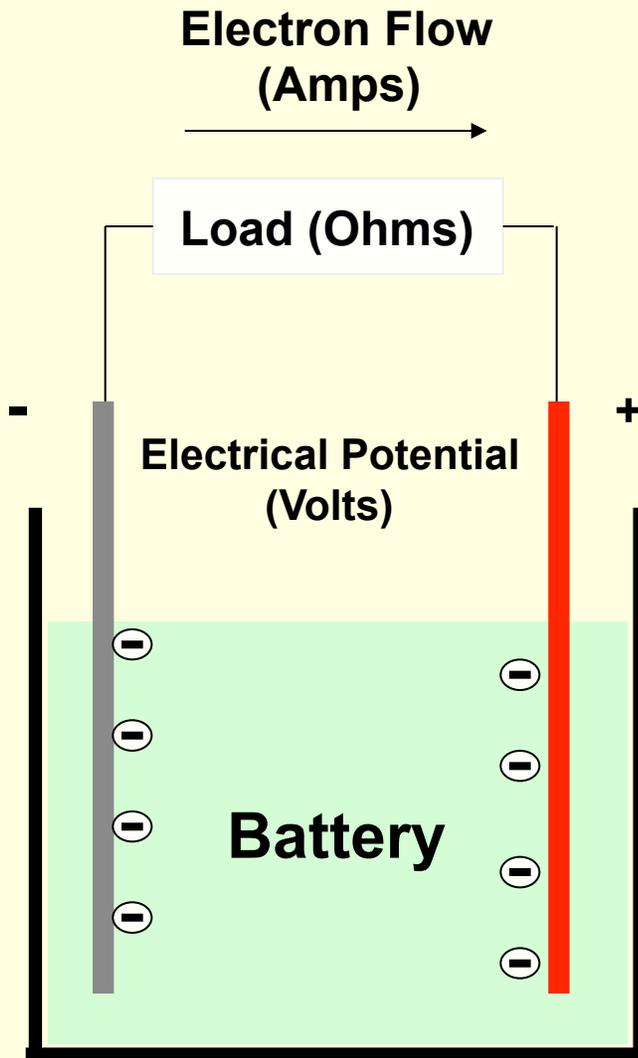
Ken's Clock Clinic
Clock Restorations, Vintage Dry Cells, Synchronizers

Basic Skill Level

- Basic clock repair skills and equipment
 - Assembly, disassembly, cleaning
 - Polishing pivots, rebushing
- Mini Lathe skills (eg Sherline, Unimat, Prazi)
 - Ability to make simple replacement bearings, washers on lathe
 - Ability to re-cut disastrous pivots and re-pivot occasionally
- Electricity Basics
 - Understand (or at least respect) them
- Soldering skills and tools (including working with solder paste)

Review of Electricity Basics

Elements of Electricity



Ohm's Law:

$$\text{Voltage} = \text{Amps} \times \text{Ohms}$$

Also,

$$\text{Amps} = \text{Voltage} / \text{Ohms}$$

$$\text{Power (Watts)} = \text{Amps} \times \text{Volts}$$

$$\text{Power (Watts)} = \text{Volts}^2 / \text{Ohms}$$

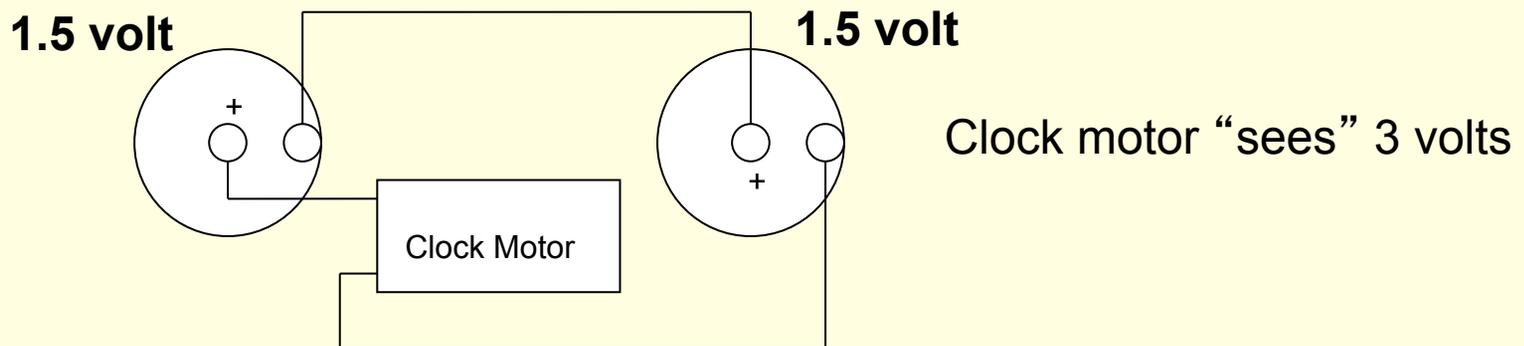
Power (watts) is related to energy

Remember: kW-Hrs is energy usage

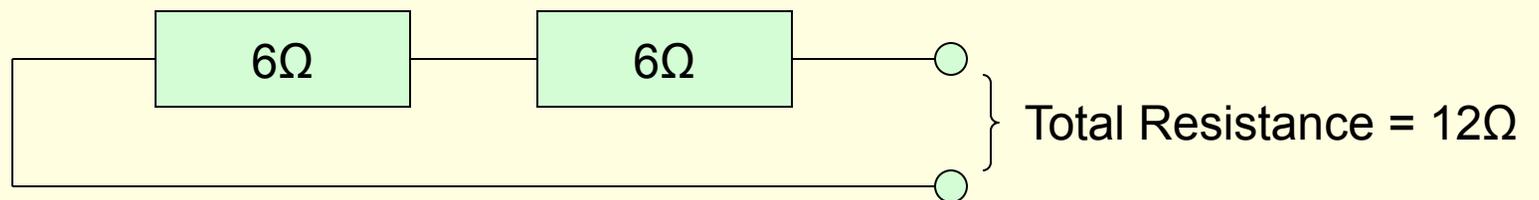


Series Circuits

- Batteries in **SERIES** add:

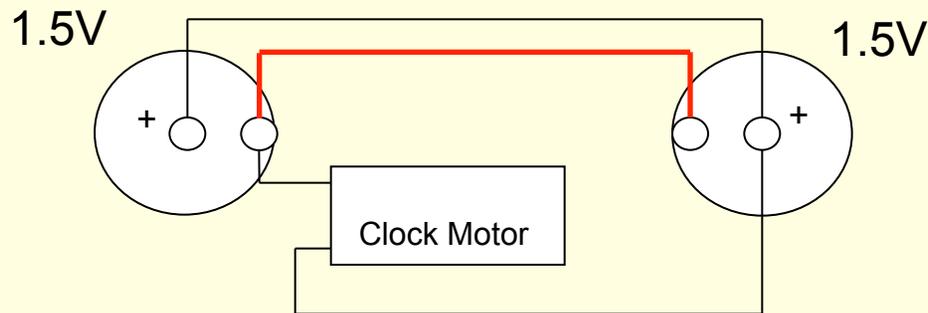


- Resistors in **SERIES** also add:



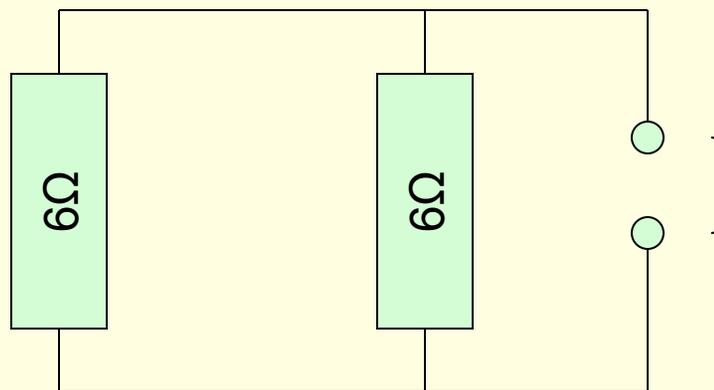
Parallel Circuits

- Batteries in PARALLEL of same voltage will output that voltage, but increase Amperage capacity



Clock motor “sees” 1.5 volts

If each battery can supply 2 amps, two in parallel can supply 4 amps.



N like value resistors in parallel reduce by:

$$R_p = R/N$$

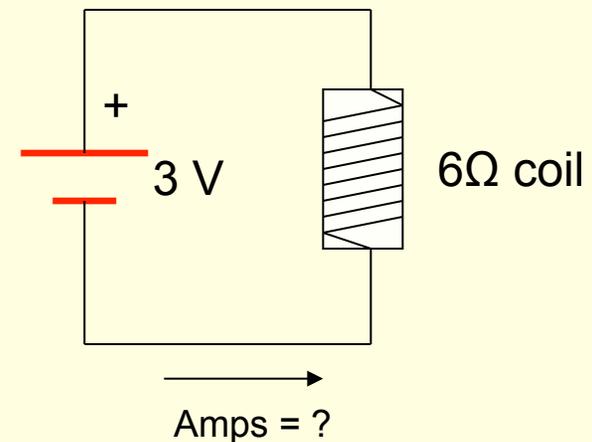
$$6\Omega // 6\Omega = 3\Omega$$

Example Application of Ohm's Law

Coil resistance = 6Ω

Battery voltage = 3 volts

How many amps will be needed from battery?



Answer:

$$\begin{aligned}\text{Amps} &= \text{Volts/Ohms} \\ &= 3 \text{ volts/ } 6\Omega \\ &= \frac{1}{2} \text{ Amp}\end{aligned}$$

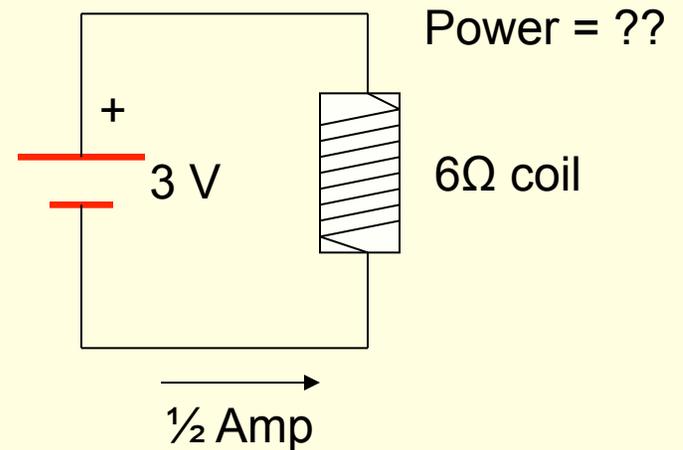
Let's keep going.....

- For the same circuit:

How much power is dissipated in the coil?

Answer:

$$\begin{aligned}\text{Power} &= \text{Voltage}^2 / \text{Ohms} \\ &= 3^2 \text{ volts} / 6\Omega \\ &= \mathbf{1.5 \text{ watts}}\end{aligned}$$



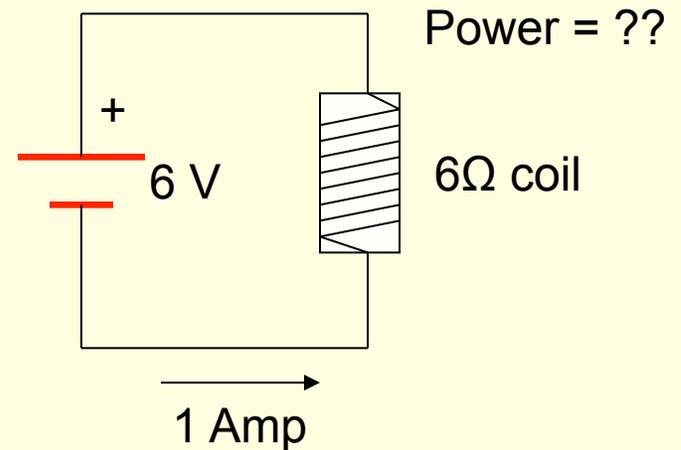
One more time...

- For the same circuit:

How much more power is dissipated in the coil if we use a Lantern battery which is 6 volts?

Answer:

$$\begin{aligned}\text{Power} &= \text{Voltage}^2 / \text{Ohms} \\ &= 6^2 \text{ volts} / 6\Omega \\ &= \mathbf{6 \text{ watts or } 4x \text{ more}} \\ &\quad \mathbf{\text{than with } 3 \text{ volts!!}}\end{aligned}$$



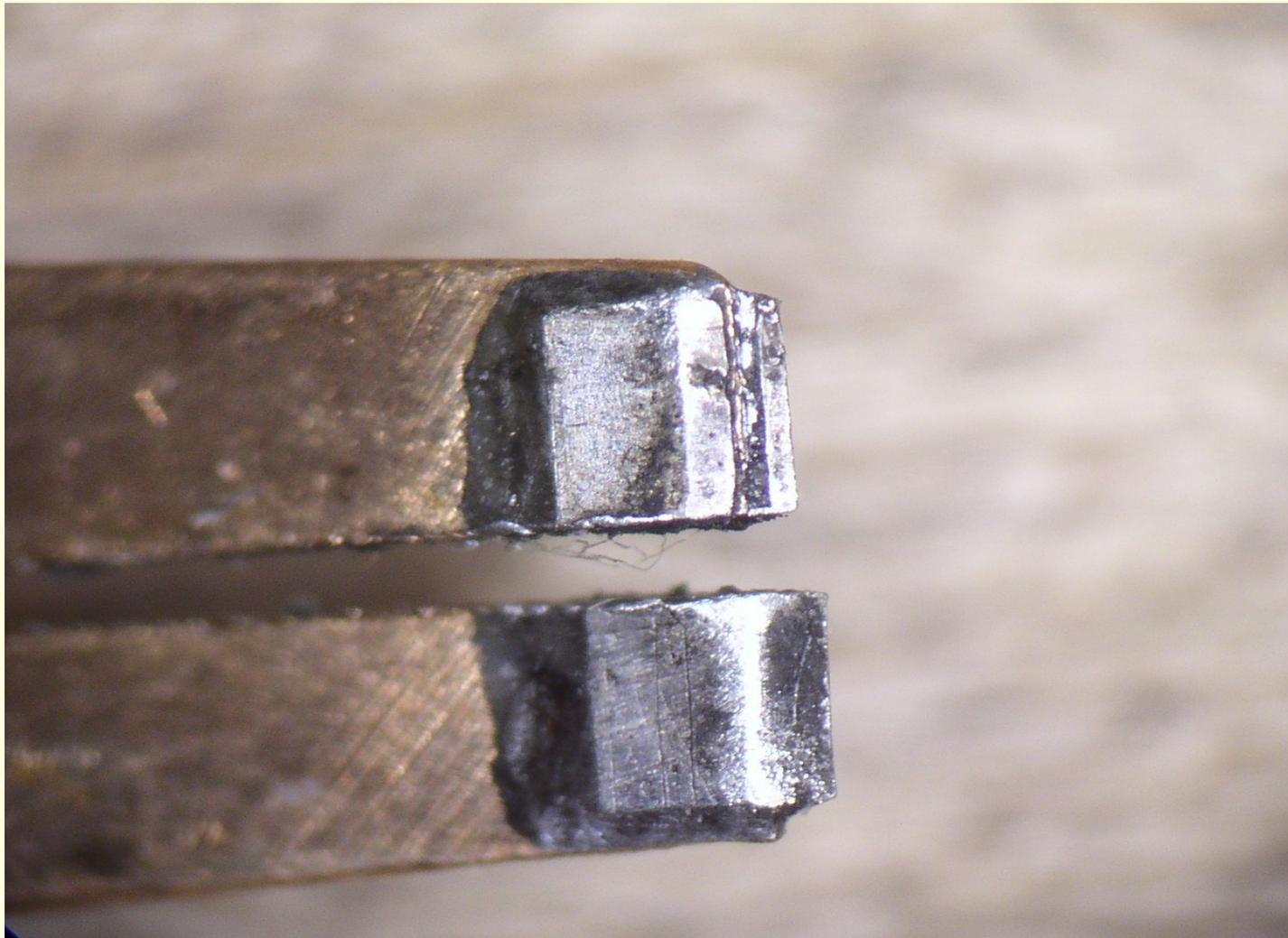
Very important lesson.....



- Double the voltage (6V) forces 4x the energy into the electrical components

- **DO NOT USE** in 3V clocks

Damage Done by 6 Volts



Ken's Clock Clinic
Clock Restorations, Vintage Dry Cells, Synchronizers

More Damage Done by 6 Volts



Style F Restoration

Preliminary Thoughts: Style F Restoration

- To do the job right is TIME CONSUMING
 - No short cuts
 - Will take 12-14 hours depending on condition
- Many SWCC have never been cleaned
 - Many have never been rebushed properly if at all
- You'll find most in sorry shape
 - Problems that spring wound clocks do not have
- Intimidating and unfamiliar to many

Preparation

- Due to clock weight and size, many customers will only send (or bring) the movements
- Make sure you have hand nut and hands
 - Many problems are hand-fit related
 - If you are repairing the sync mechanism you need to adjust the hand bushing
 - Second hand is essential to sync adjustments
- Make up some test stands with various pendulum lengths

Organizing the Restoration

(A trip to a container store is a must!)

- Container for small brass parts

- Brass Washers
- Terminals
- Nuts, studs



- Container for:

- Steel parts and screws



- Container for:

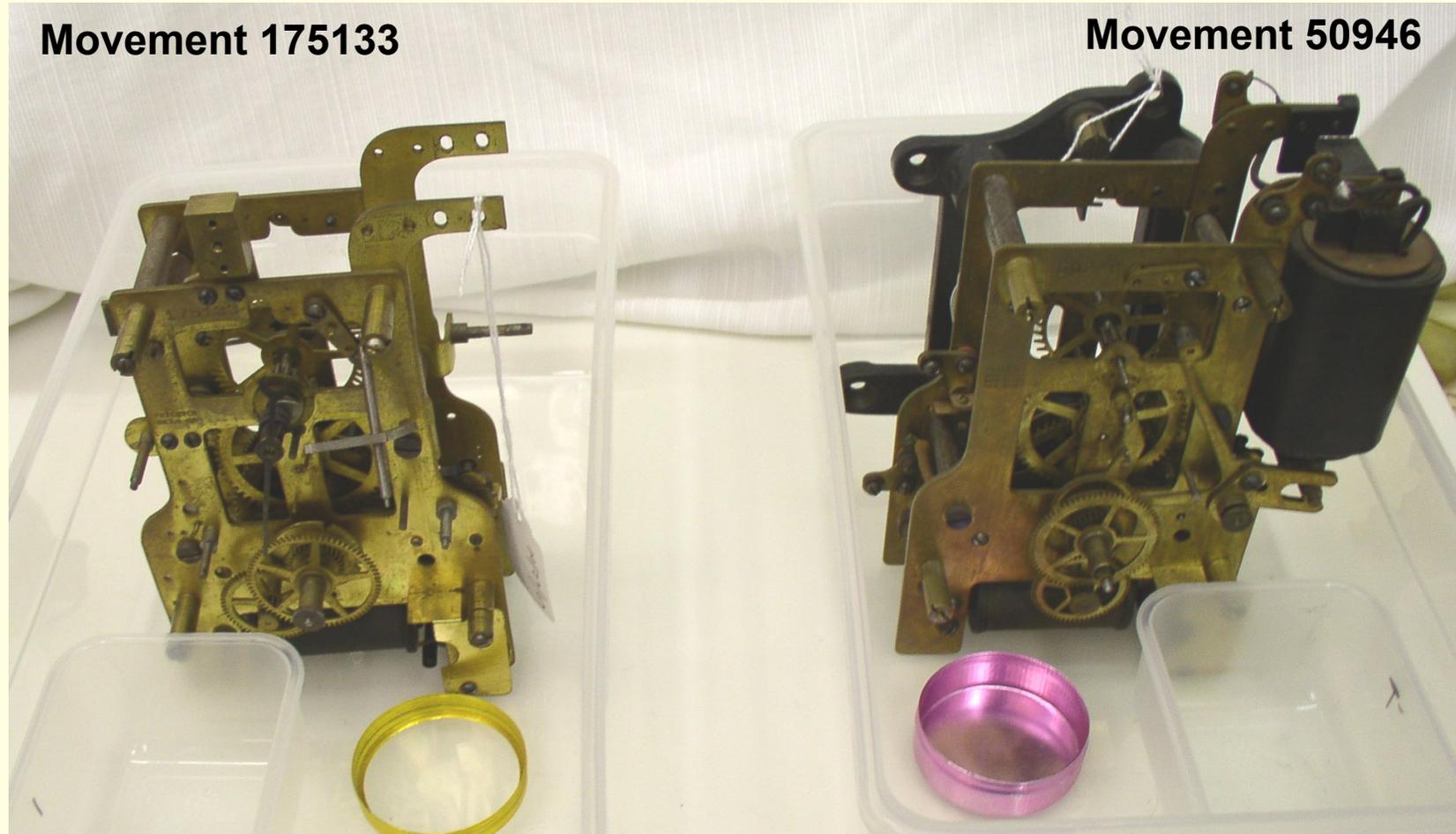
- Movement wheels, levers, Plates and plate extensions



- Safe storage for Rubber insulators
- Safe storage for coils/resistor assembly

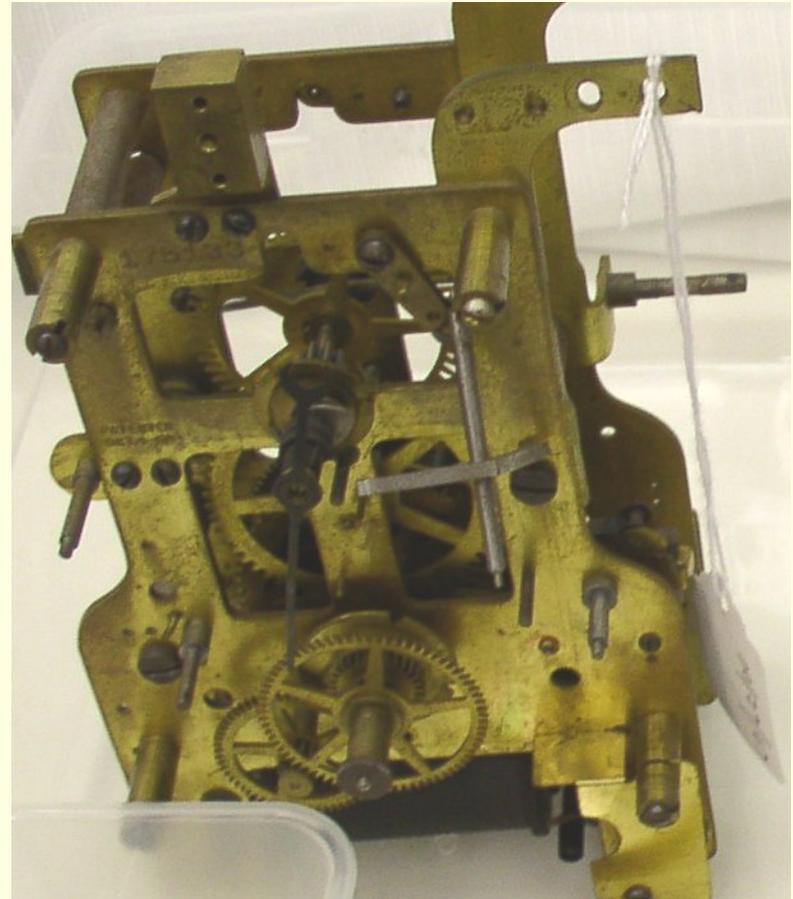


Getting Ready



Movement 175133 Description

- **120 Beat movement**
- **Customer: “Circa 1927”**
- **Damping resistor missing**
- **Bell System central office LD billing timer (Telco)**
 - Switch missing
- **Minute cam, notched hour wheel for hourly sync**
 - Switch missing
- **Hourly and minute synchronized**
 - Coils, levers missing
- **Double thick insulators**



Disassembly Tips--Fasteners

- Make careful notes of which screws go where
 - Wrong LENGTH screws will cause problems
 - Compare to reference table
- Keep track of where brass washers go
 - Under screws holding coil yokes
 - Under screw head above insulator, if there is a wire lug involved
 - Between nuts and insulators
 - NOT under screws holding ONLY insulators

Screw Sizes SWCC Style A, F

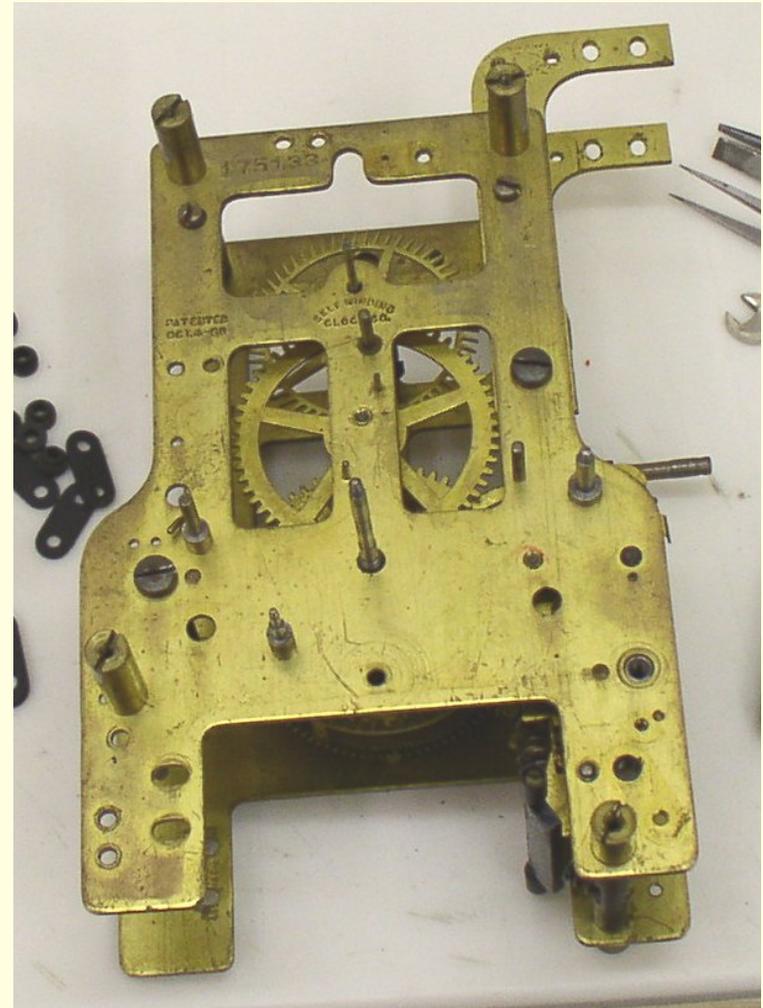
Location	OD (inch)	Thread (TPI)	Screw Size
Hand Nut Style A (and some F as well)	0.103	50	M2.8 x .5 (M3.0 x .5 oversize but works)
Hand Nut Style F	0.98	50	M2.6 x .5 (no commercial cutters available)
Sync arm & Minute wheel nuts	0.085	56	2-56
Electrical Connections, Dial Screws	0.110	40	4-40
Verge Bridge (front and rear)	0.124	40	5-40
Bosses, Pillars	0.138	40	6-40
Motor Coils	0.136	32	6-32
Sync Second Bit Escape Arbor	0.048	125 (est)	M1.2 x 0.2 (closest fit)

Screws

- Keep an eye on threads
 - Years of heavy tightening damages them
 - Rethread or clean up per table
- Be careful of screw sizes
 - Many different types on these clocks
 - Some look the same but don't interchange
- Some are shoulder screws
 - Upper right pillar front (spacers) and rear

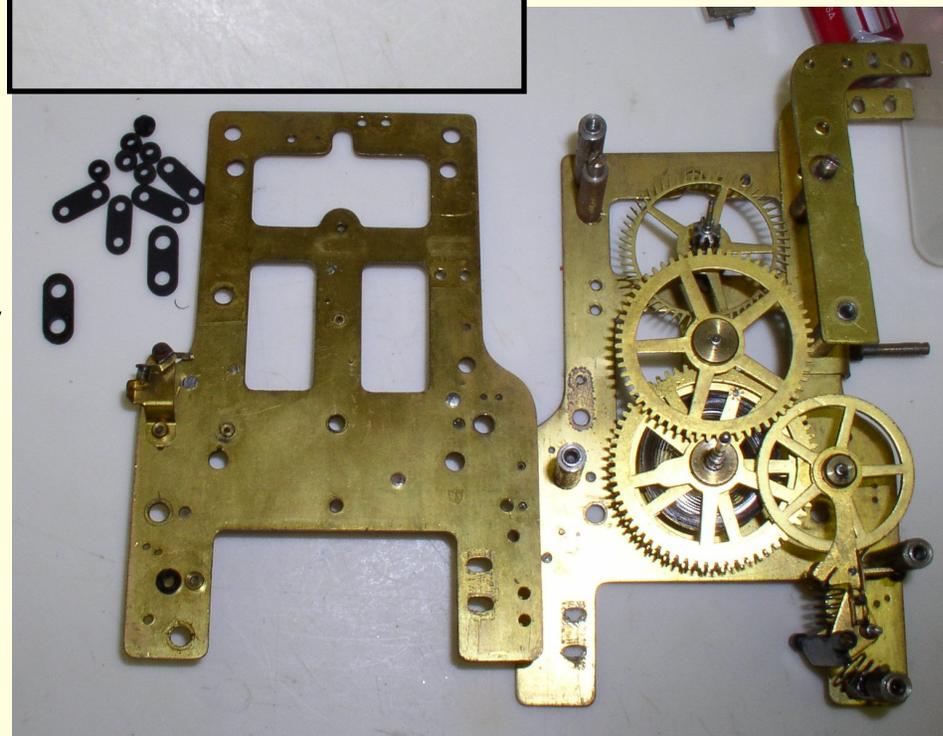
Starting the Disassembly

1. Remove Motion Works
 - Synchronizer levers
2. Remove Verge
 - Let down train slowly
3. Remove Coils
 - Disconnect wires first!
 - Winding Coils with Damping Resistor
 - Synchronizing Coils
4. Remove contacts
 - Hourly Contacter
 - Both motor contacts

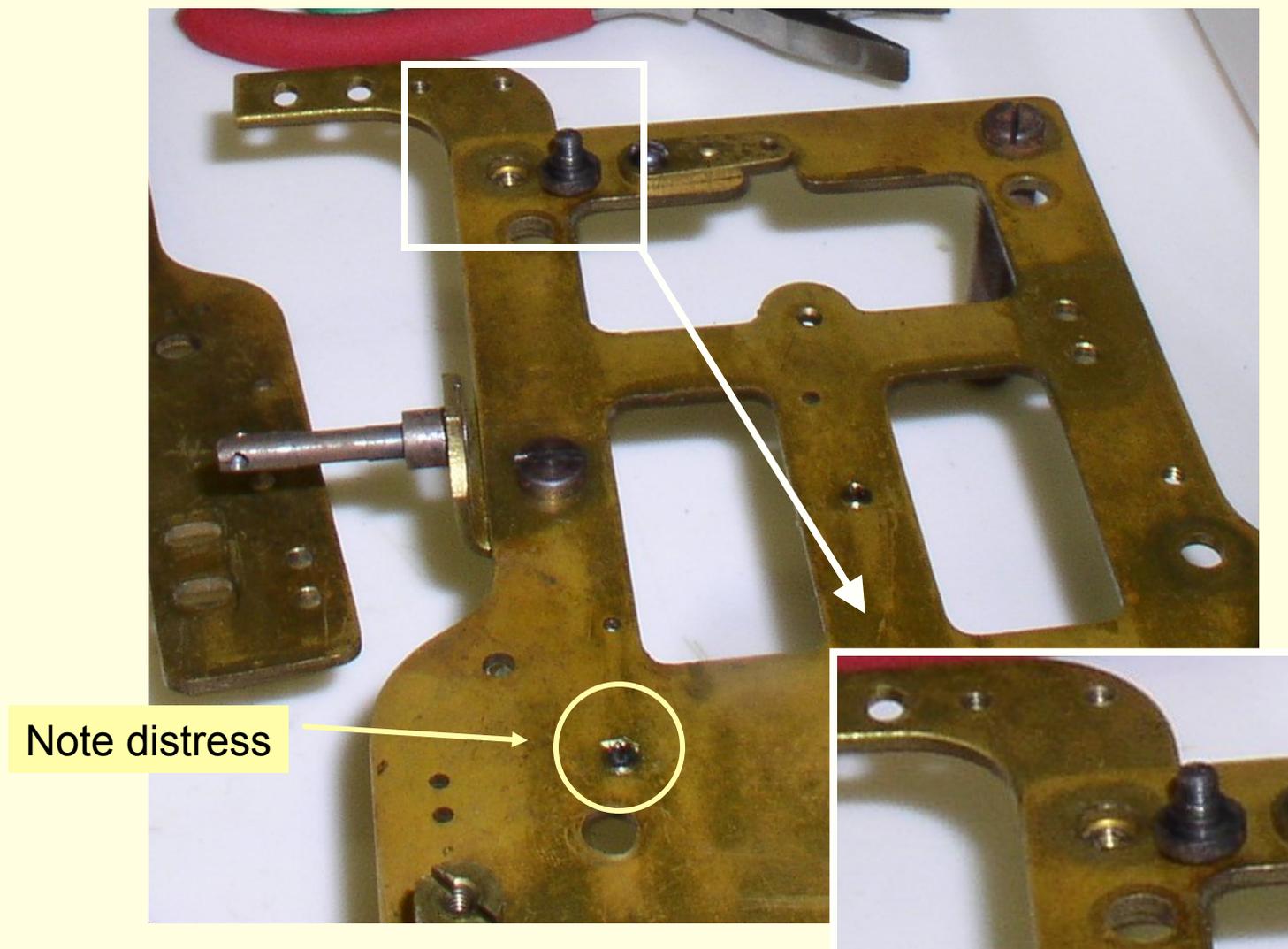


Finalize Disassembly

1. Remove top plate spacers and screws
 - Note differences!
2. Remove top plate
3. Remove all wheels and set aside
4. Main Wheel disassembly

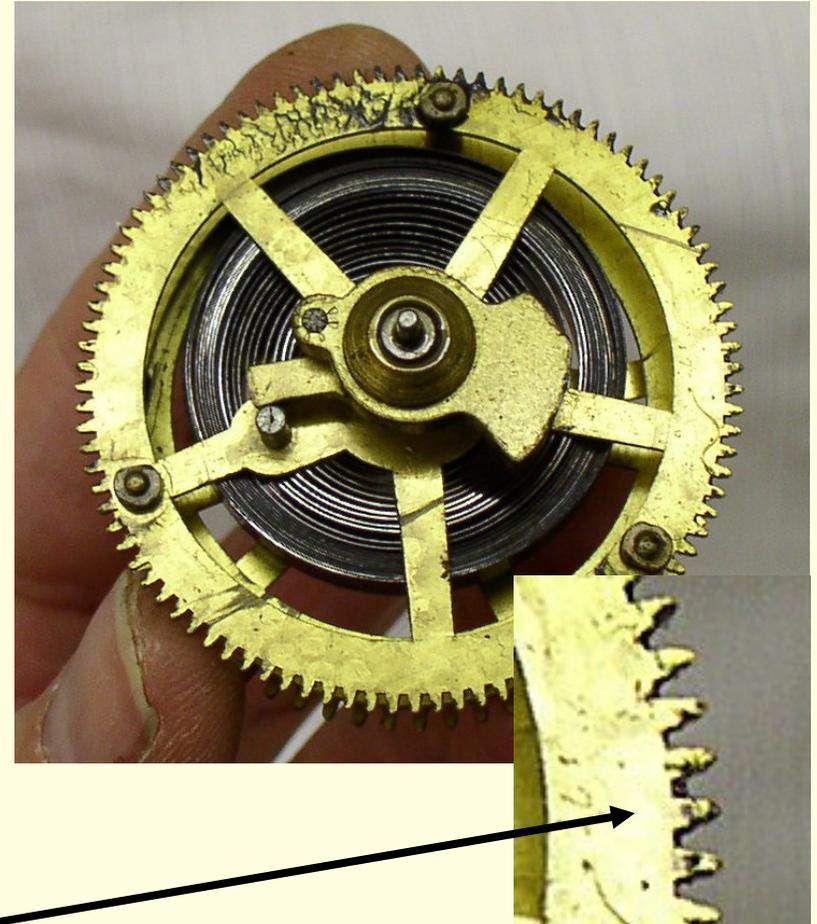


Note Rear Plate Shoulder Screw



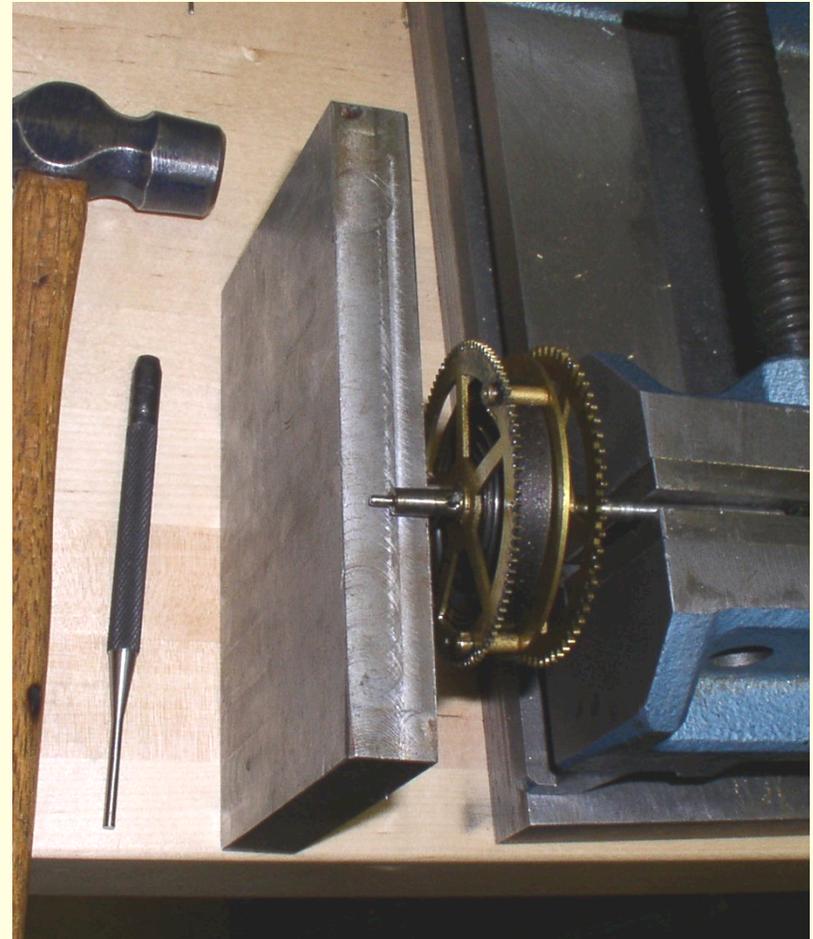
Main Wheel Disassembly

- Note mainspring is wound too tight
- Counted 6 turns prewind on this one
 - Spring is .220" x .010" x 84"
 - Would work with 4 turns prewind
- Will eat batteries and wear out movement
 - Note tooth wear, inset



Removing Center Arbor Pin

1. Use Vise as 3rd hand
2. Bench block to support rear arbor near pin
3. Drive out pin with drift punch
4. Remove nuts on barrel and remove driven wheel
5. Use same approach for mainspring collet, too



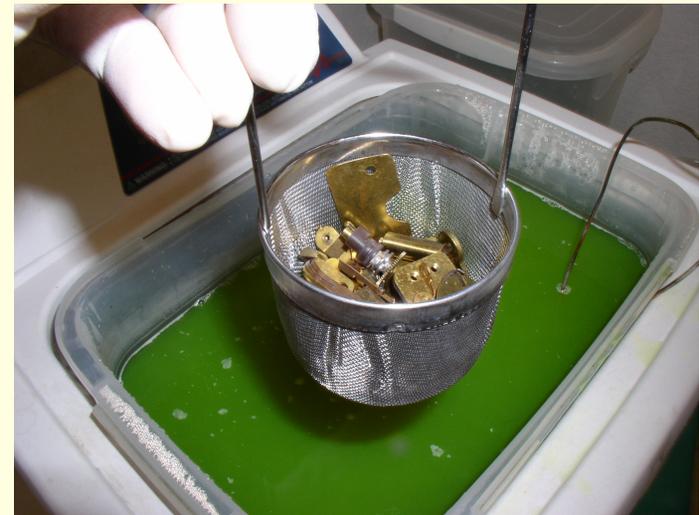
Removing Mainspring

1. Unhook center of spring from pin
2. Grasp mainspring with fingers
3. Pull up and out
4. Slowly allow spring to unwind
 - Clean off heavy grease



Cleaning

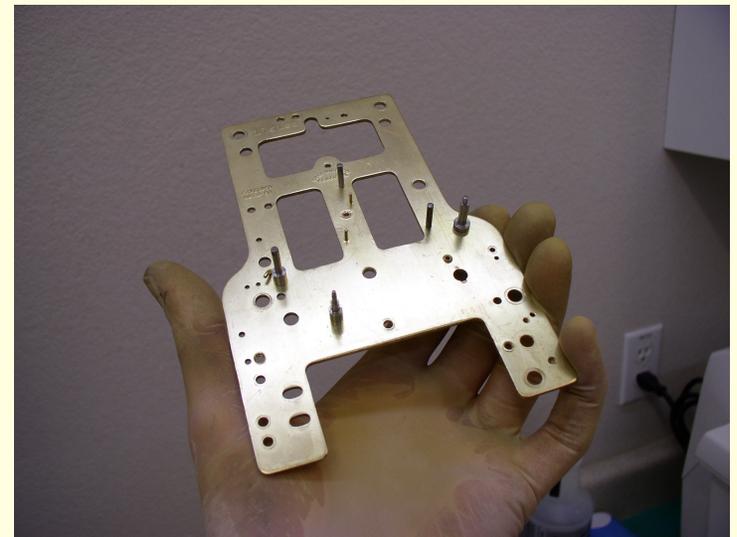
- Separate parts into baskets
 - Small brass parts
 - Wheels
 - Steel parts
- Clean plates and large parts separately
- Ammoniated cleaner ok for most parts
- Can use Zenith 77 for insulators



Brushing

- Use brass bristle brush
- Cleans oxide away
 - Better electrical contact
 - Makes it easier to see what you are working on later
- Cost: \$7.70 per 4 movements
- Torrington 04046 - .006" Brass Wire Platers Brush

www.torringtonbrushes.com/curved-handle-style-platers-brushes.html



Rust Removal

- Pillars, screws, possibly pinions
- Rust is heavy and stubborn
- Use “Evapo-Rust”
 - Biodegradeable
 - pH Neutral
 - Safe on plastics and brass

www.theruststore.com/Evapo-Rust-Gallon-P1C1.aspx



Electrolytic Cleaning

- Removes corrosion
- Removes tarnish
- Optimizes electrical connections
- For contacts, contact studs, washers, nuts
- Process:
 - Clean in Ammoniated Clock Cleaning Solution
 - Water Rinse
 - Dip 8-10 seconds Rosheene CB (or Jax)
 - Water rinse thoroughly
 - Neutralize with Clock Cleaning Solution
 - Water Rinse and dry
- Alternative to Rosheene CB:
 - Jax Instant Brass and Copper Cleaner

<https://jaxchemical.com/shop/jax-instant-brass-and-copper-cleaner/>

**THESE CLEANERS ARE DANGEROUS! USE PROPER PRECAUTIONS
AS INSTRUCTED ON PRODUCT LABELS**



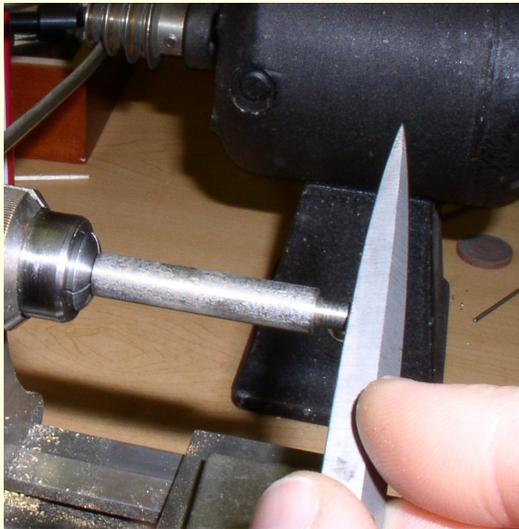
Mechanical Restoration

- Clean mainspring
- Restore screws & steel pillars
- Restore ratchet wheel and winding ratchet
- Polish all pivots
- Restore Barrel Cage Bushing
- Polish armature pivots
- Replace impulse pin if needed
- Plate Work (bushings)
- Restore winding detent pin
- Reassemble center wheel
- Clean up Coils



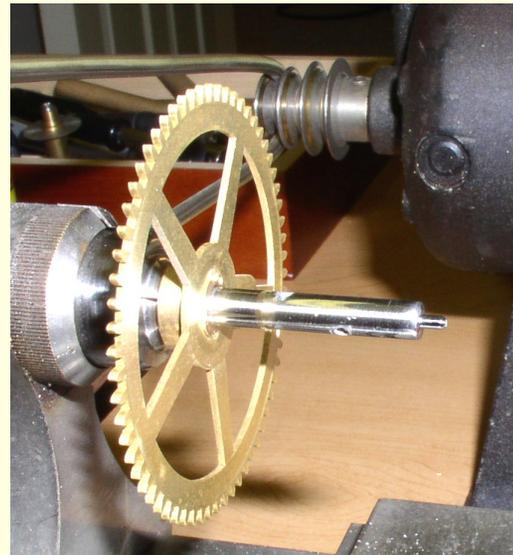
Pillars and Screws

- De-rust pillars, then clean up screw head with file (using lathe)
- Use 320 paper to clean up file marks
- (Optional) Use green abrasive pad to remove oxides and restore luster to overall pillar



Main Wheel Repairs

- **Polish out wear from center arbor and pivot**
 - Cut with pivot file, 400 Wet-or-dry, polish with 1200 then 2500
 - Burnish front and rear pivots
 - If necessary (and often is), replace barrel cage bushing



Tighten Main Wheel Bushing

- Always check at this stage
 - Impossible to correct later
- Requires movement tear down to correct
 - DON'T solder in situ
 - Inspect on every restoration



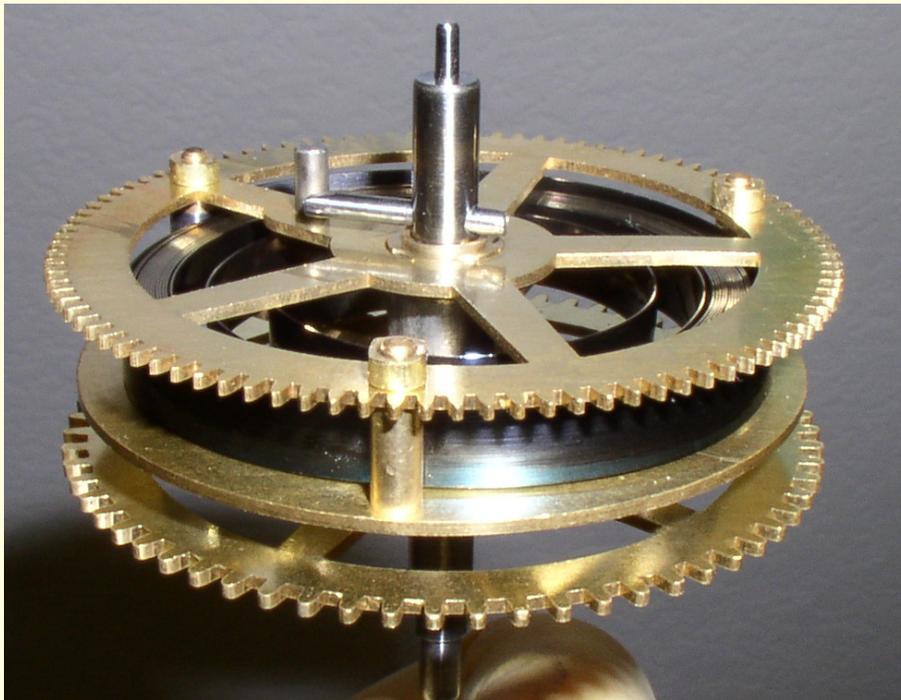
Barrel Cage Bushing Replacement

- Knock out original
- Turn up new part on lathe
- Make new bushing and install as shown



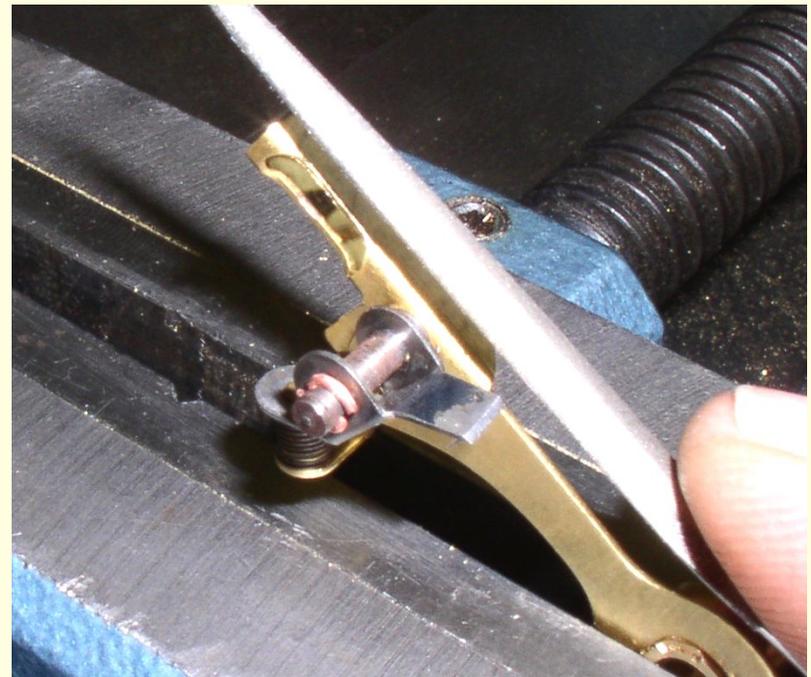
Completed Main Wheel

- Clean mainspring, dry and rinse in Boeshield T-9 solution
 - Boeshield T-9 diluted 2:1 with Naptha
- Note orientation & cut of center arbor pin
- Center arbor pin must clear winding wheel pin by .04”



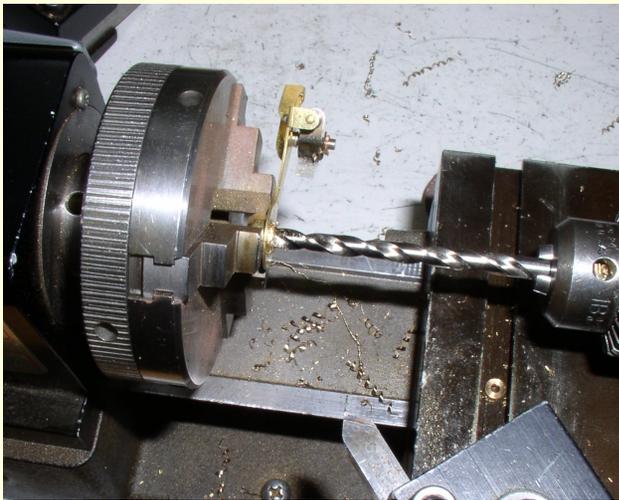
Winding Lever Repairs

- Clean up Pawls
 - Often disastrously worn
- NEVER leave them dead sharp!
 - Slight radius so they cannot cut into the wheel

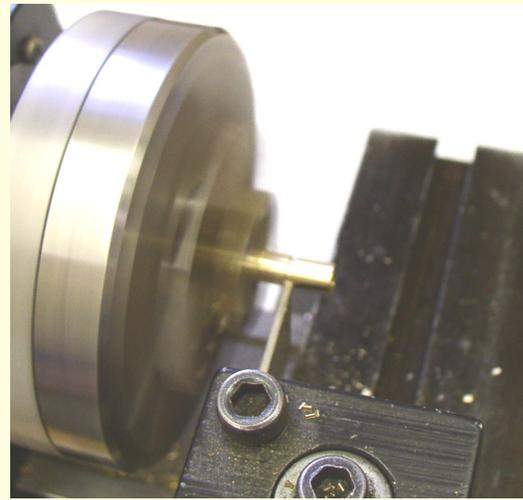


Winding Lever Repairs

- Rebush Center Hole
- Often neglected—Don't!
 - Consequence is inefficient, noisy or missed windings



Drill out Center Hub
Use .140" drill (#28)



Turn up sleeve from .140" stock
Center drill .116" (#32) or to fit
Part off to length (~.205")



Taper hole with broach
Drive home sleeve
Open with Alvord-Polk reamer

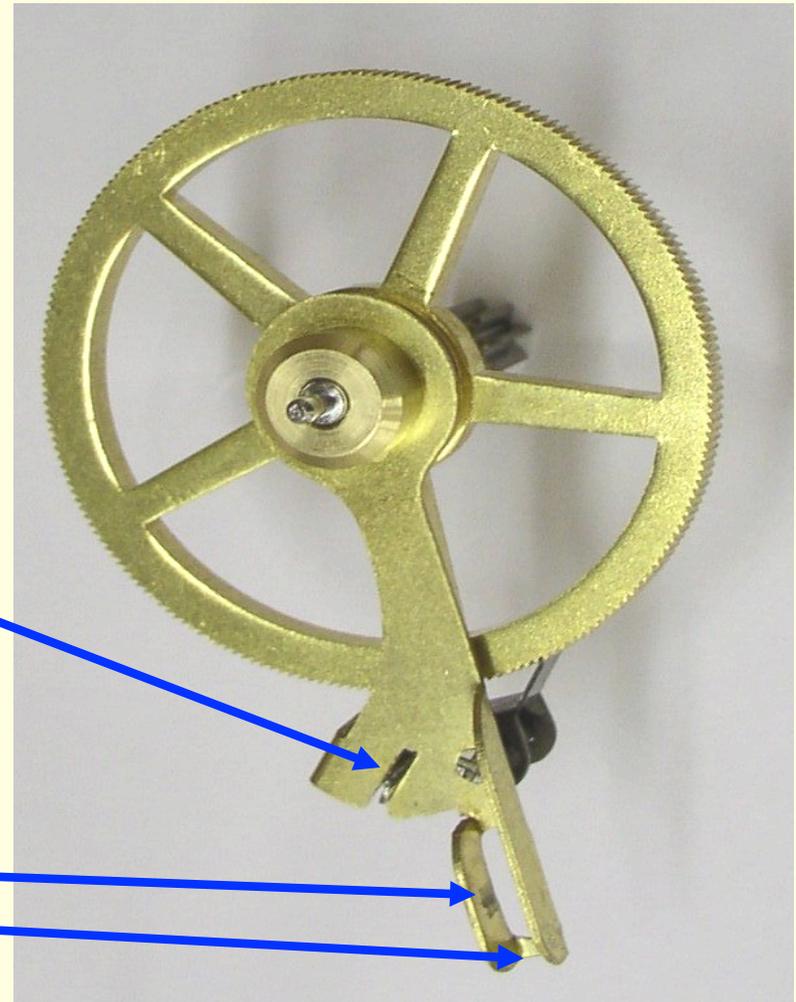
Winding Arbor

- Another often neglected repair
 - Abusively worn
 - Remove wear and polish like a pivot
- Proper polishing assures long life & snug fit of ratchet



Winding Lever and Arbor

- Polish upper arbor like a pivot
- Inspect opening for cracks
- Inspect springs for Rust
- Adjust so that at rest, stop is in center of groove

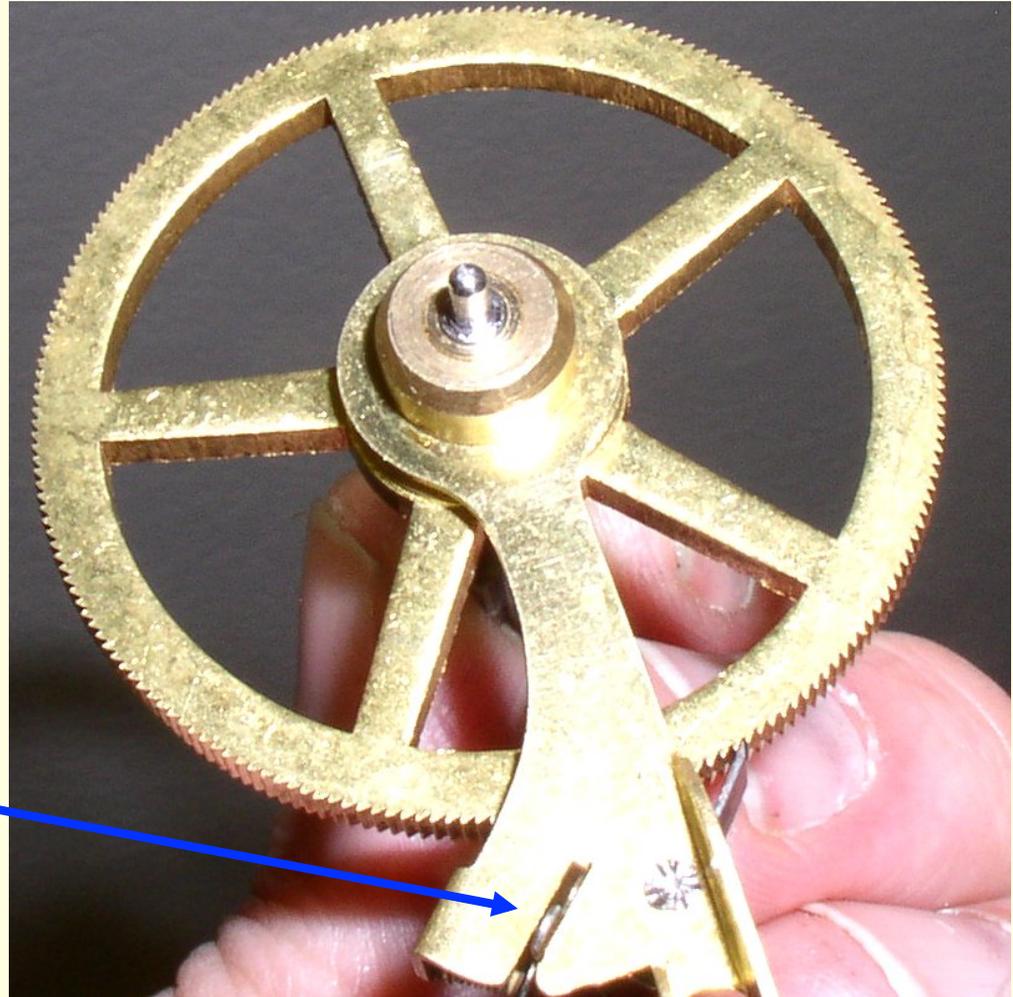


Look for cracks here

Completed Winding Ratchet

- Bushing snug fit but turns freely
- End shake at pawl tip <.020”
- Sleeve is invisible
- Pawl square to wheel

Stop in center of groove



Armature Repairs

- Pivot wear is serious
 - Bushing will quickly wear once pivot is scored
 - Must be addressed
- Pivot is difficult to access
 - If wear is minor, use rouge wheels to clean up
 - If step is evident, it must be disassembled
- Bumpers must be removed with proper size screwdriver
 - ...OR THEY WILL CRACK

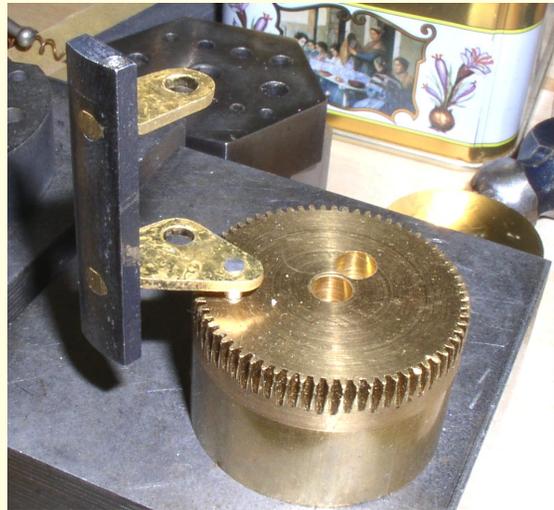


Armature Repairs

- Remove upper and lower bumpers
- Use Loctite Threadlocker 222 when reassembling
- Be sure no cracks in bumpers (turn up new from .156" OD Delrin)



Impulse pin substantially worn
Step worn on pivot



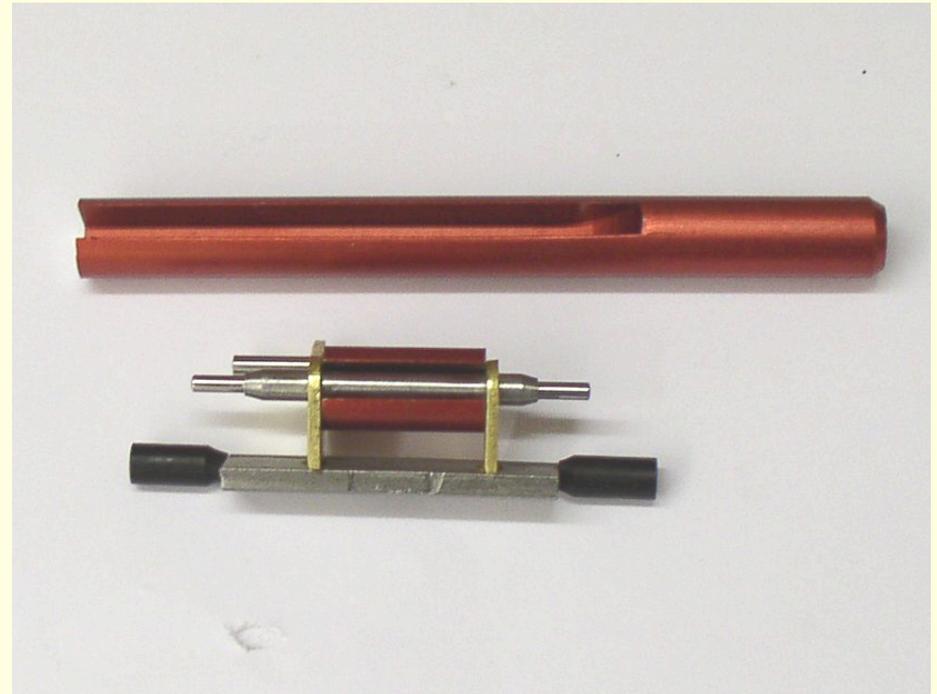
Knock out pin
Make new pin from .093" stock
Rivet using block as shown



Finished assembly

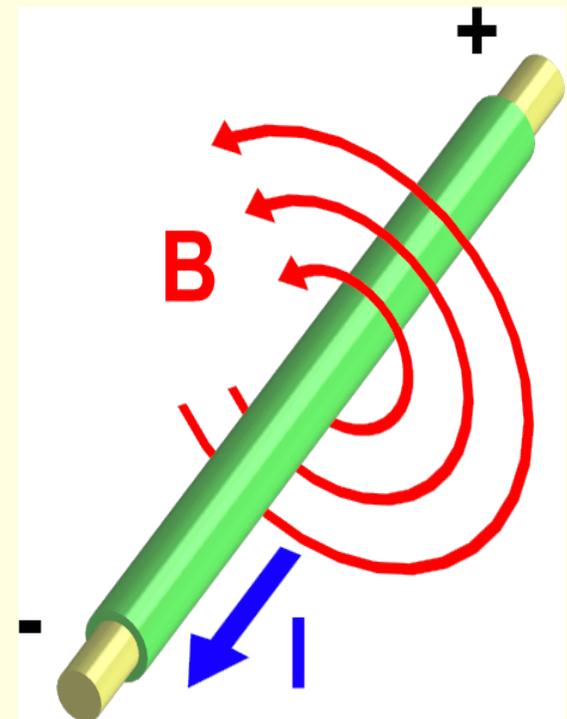
Accessing Armature Pivots

- Must remove arbor
- Make tool from Cannon Pinion punch (Timesavers 20879)
- Acts as spacer as you drive out arbor



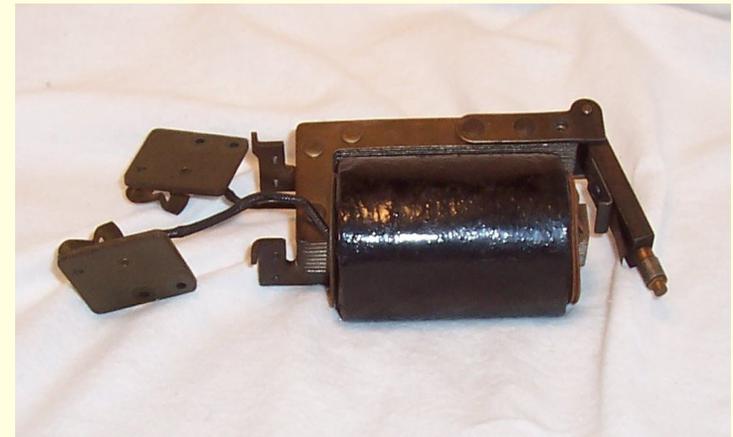
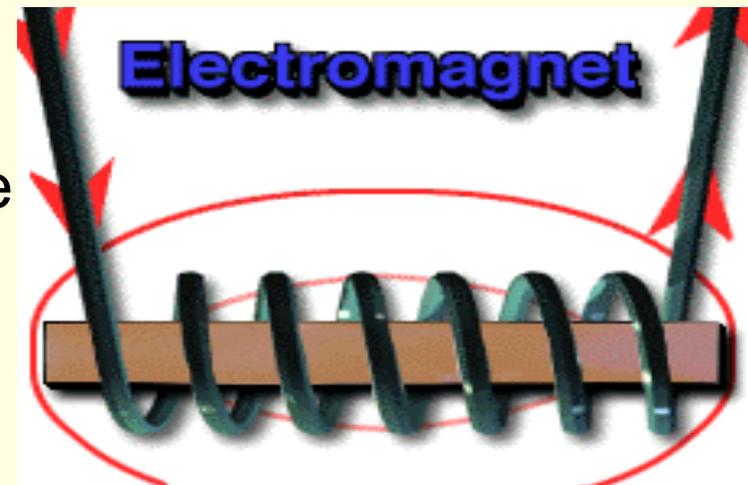
Coils and Electromagnets

- If a current is passed through a wire, a magnetic field results
- This magnetic field encircles the wire as shown.
- The magnetic field will form around magnetic materials if we let it



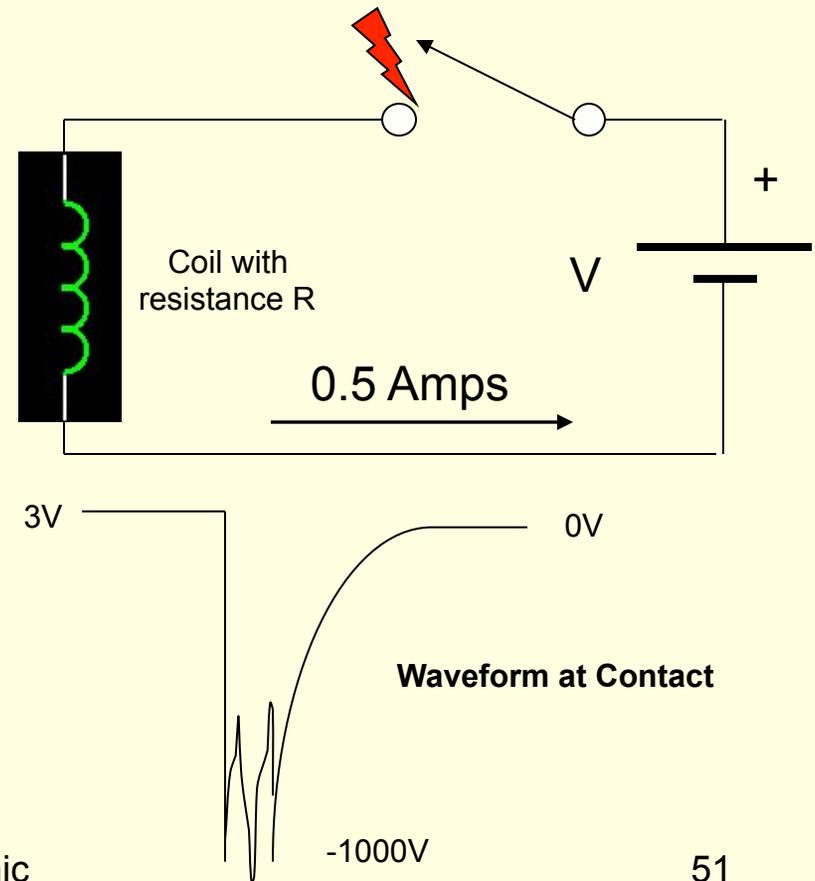
Coils and Electromagnets

- Winding multiple turns around a core will concentrate the magnetic field as shown.
- All coils have some winding resistance resulting from the copper
- Amps = $V / (\text{coil } R)$



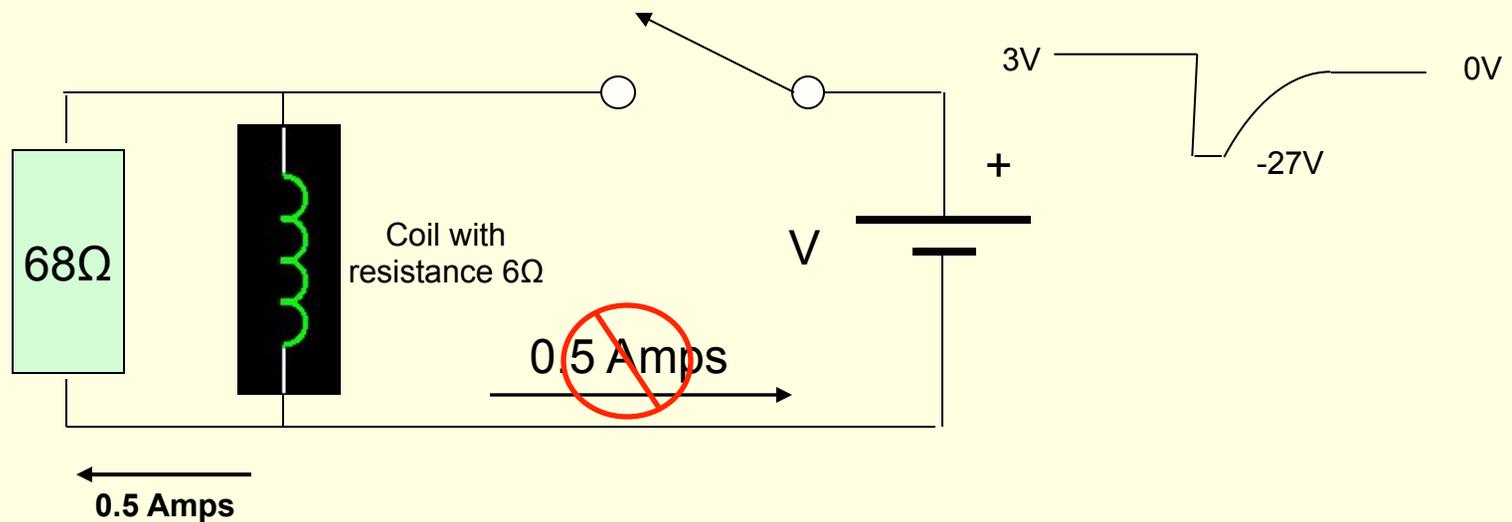
Challenges with Coils

- What happens when we disconnect the coil?
 1. Energy is stored in the coil as an electromagnetic field resulting from the current flow.
 2. When the switch is opened, this energy needs to go somewhere.
 3. Voltage across the contacts increases until contact arcs over (100's or 1000's of volts).
 4. The "spot" temperature from this arc is hot enough to melt metal, thus pitting and damaging the contacts.



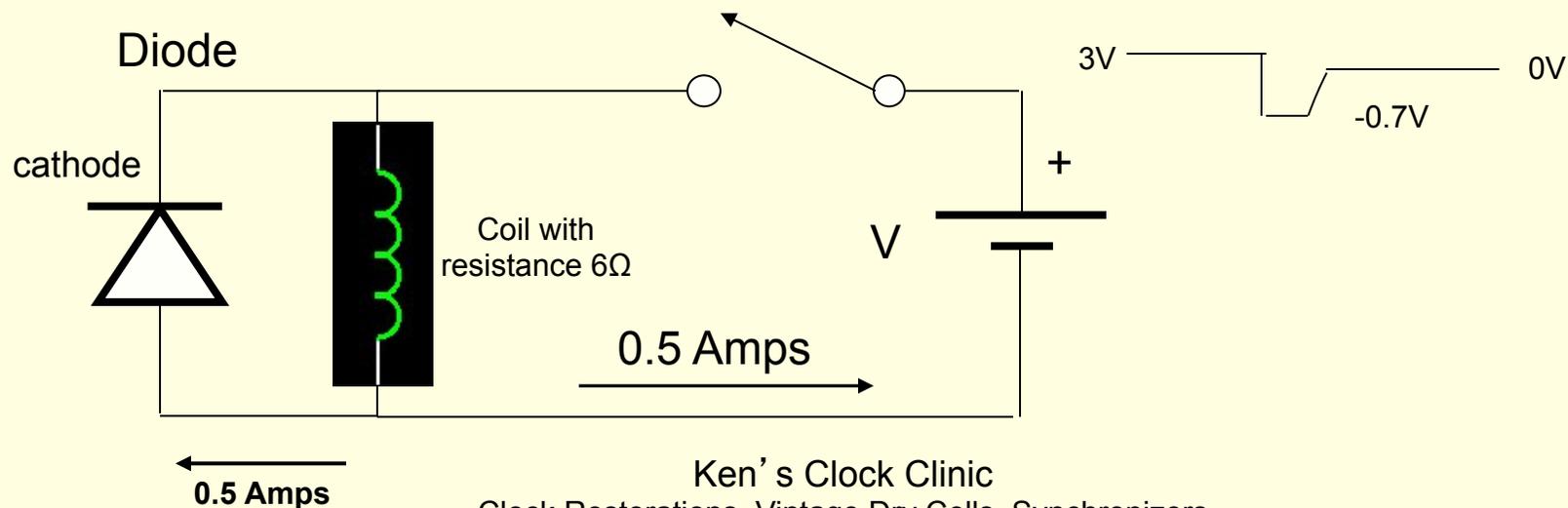
Challenges with Coils

- Question: How do I prevent this?
- Answer: Create somewhere else for the coil current to go when the contact opens.
- Most common option is a Damping resistor, usually selected to be $\sim 10x$ the value of the coil resistance.

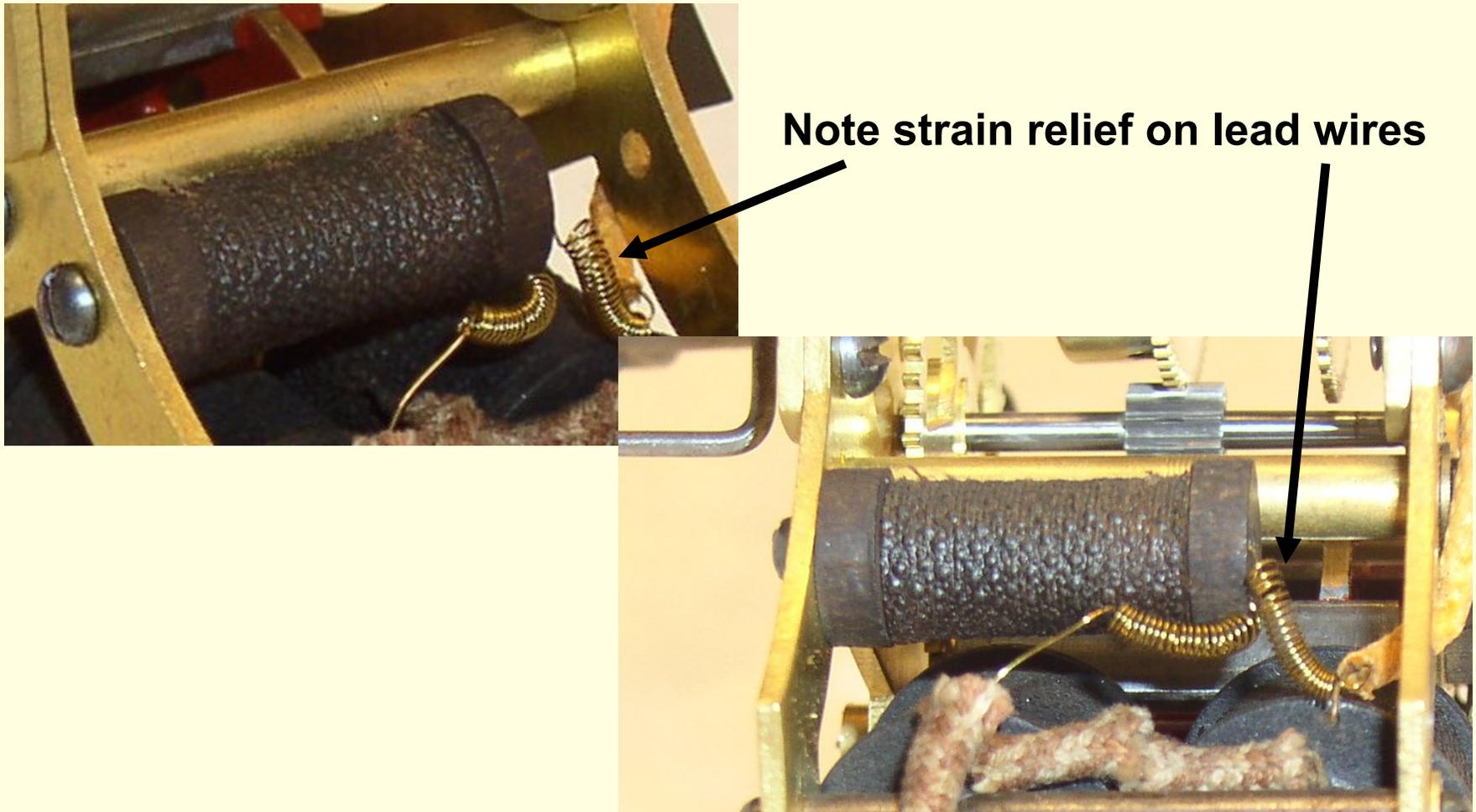


Challenges with Coils

- Another option is a diode, but this is NOT recommended for clocks
- NEVER use a diode on vintage clock motor coil!
 - Interferes with proper operation of the motor
 - Drags out release time of electromagnet and slows armature

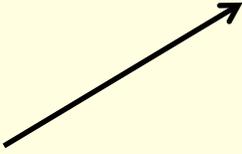


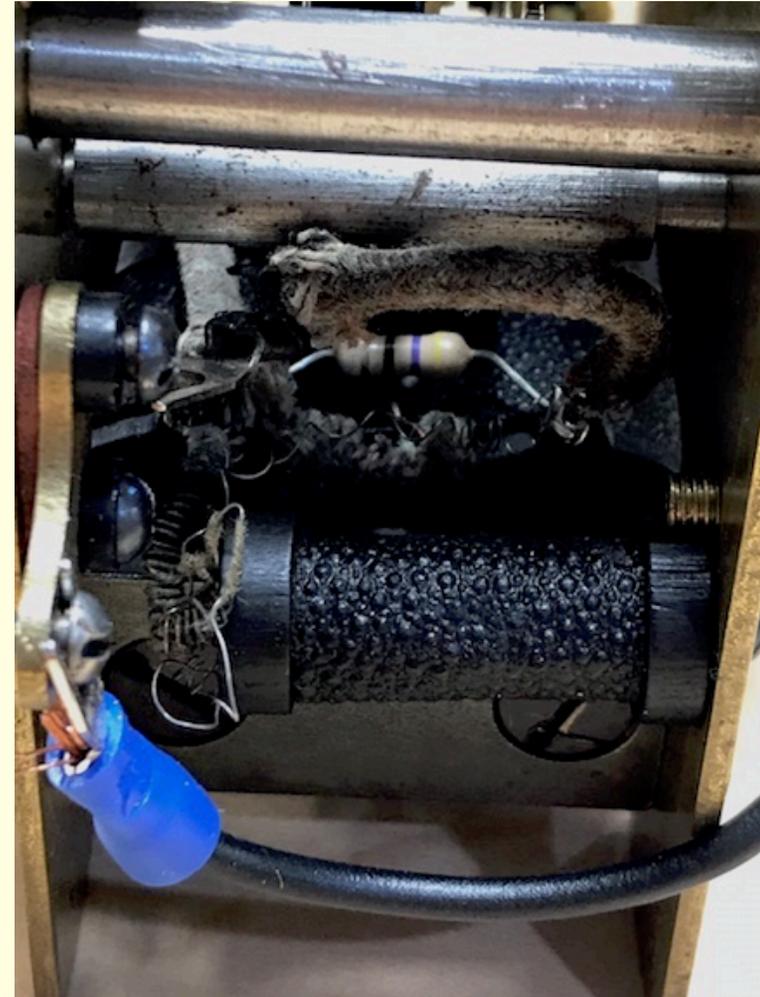
SWCC Damping Resistors



Note strain relief on lead wires

Tips on Damping Resistors

- Damping Resistor is 8-12x the value of the coil resistance
 - They are NOT optional!
- Lead wires must not be broken, touching metal or each other
 - Watch for corrosion or poor previous repairs
- Do NOT use cheap modern resistors
- Check motor contacts for blue arcs (in the dark) while winding
- Note Wall of Shame illustration 



Restoring Coils and Connections

- What if lead wire broken off at coil bobbin?
 - Don't panic—this can be repaired easily
- To repair:
 - Thread wire out of bobbin hole
 - Sometimes must CAREFULLY remove coil cover
 - Unwrap 3 turns (unwraps easily)
 - Rethread through bobbin hole
 - Clean off insulation, solder resistors and lugs on

Note: Most SWCC 3V coils are AWG 23

Restoring Coils and Connections

- Clean connections are critical
 - Use Scotchbrite wheels (#320) or steel wire on Dremel
 - Hold lugs and wires with pliers while cleaning (DO NOT STRESS WIRES)



Coil in original state



New Resistor soldered, wire and spade lug cleaned

Note: Do NOT neglect resistor! It is a critical component!

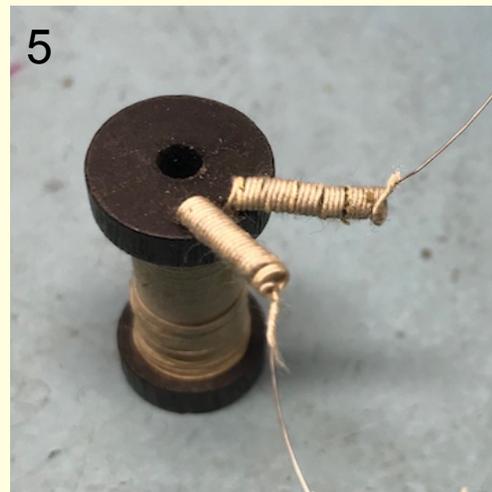
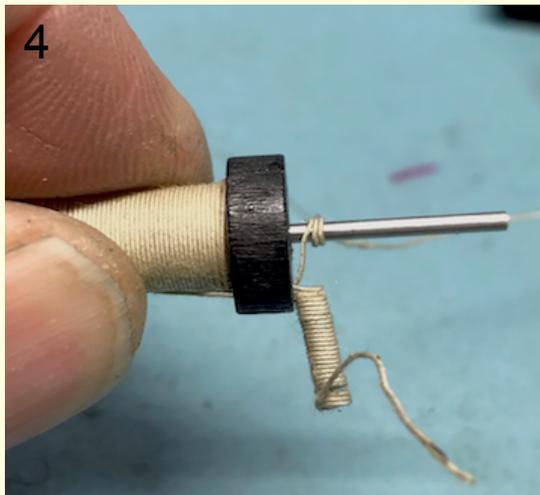
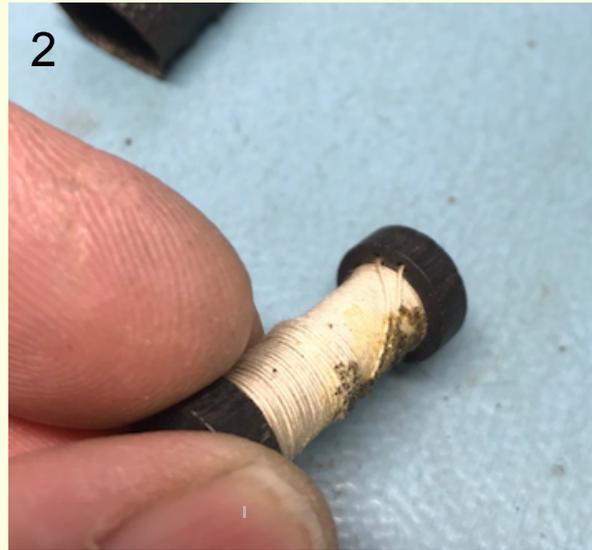
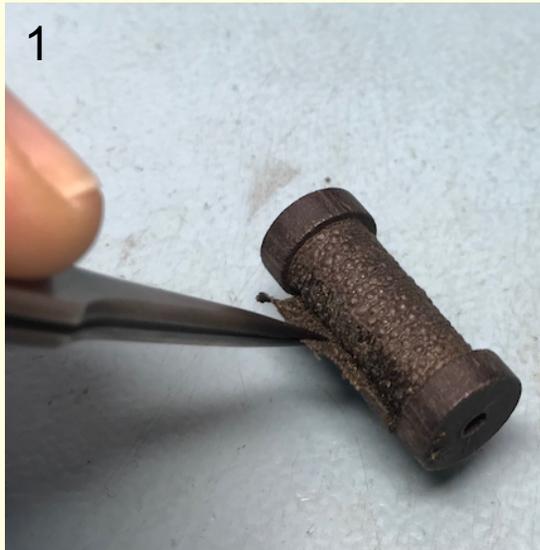
Resistors

- For post 1940's clocks use surplus Allen Bradley or Ohmite 68 ohm 1 watt resistors (RC32GF680J)
- Tough to find: check Electronics Surplus and Ebay
- For earlier clocks, either restore existing resistor or rewind



Restoring Original Wound Resistors

Also applies to coils



Rewinding Resistors and Coils

- Wires.co.uk
 - Silk and cotton covered magnet wire!
- https://www.wires.co.uk/acatalog/sc_wires.html
- Both copper and constantan (10ft)
- Do NOT use NiCr for resistors
 - Very difficult to solder
- Do NOT use un-insulated resistor wire
- For resistors, wind bifilar
 - So that you don't create an electromagnet!



Servicing Coil Paper

- If intact (most are re-usable):
 - Blow off dust
 - Clean off dirt, oil with Naptha and cloth
 - Light coat with shellac restores appearance
- If badly torn, worn or missing:
 - Camera Leather Seal Grain Leatherette
 - (NON adhesive version)
 - Cut to dimensions of original covers
 - Hide Glue to hold down (0.75" glue painted on each end)
 - Reinstall so that the seam is in the back or between coils



<http://www.cameralather.com/>

Replaced Paper

<http://www.cameraleather.com/>



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Plate Work

Bushings

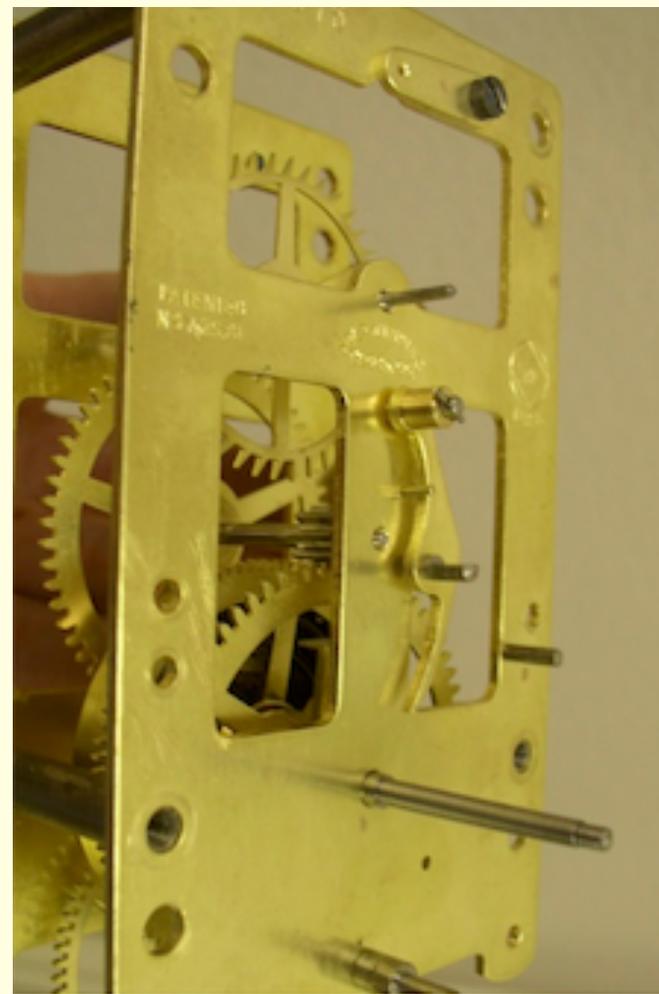
Bushings-Considerations

- Recommend custom sleeve bushings
- If not, use KWM
- AVOID Bergeon on SWCC (large holes, hogs out more brass than necessary)
- Carefully file hole back to original location
- Keep repair inside oil sink



Why custom sleeves?

- Faster, cleaner than box bushings
 - Less invasive
- Work hardens hole
- Bushing riveted in place
- Replicates original oil sink
- Cosmetically superior to box bushings

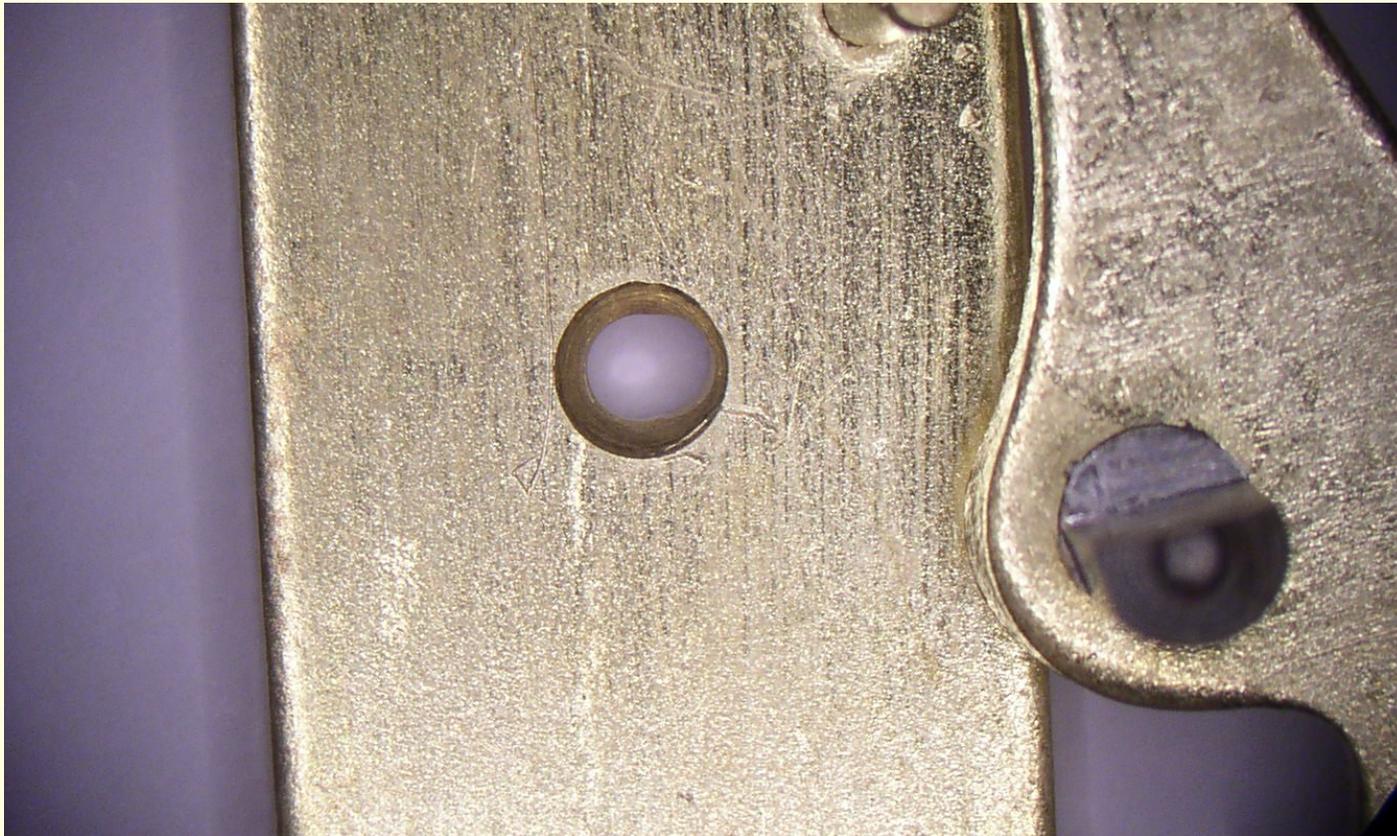


Bushing Second Wheel Front Hole

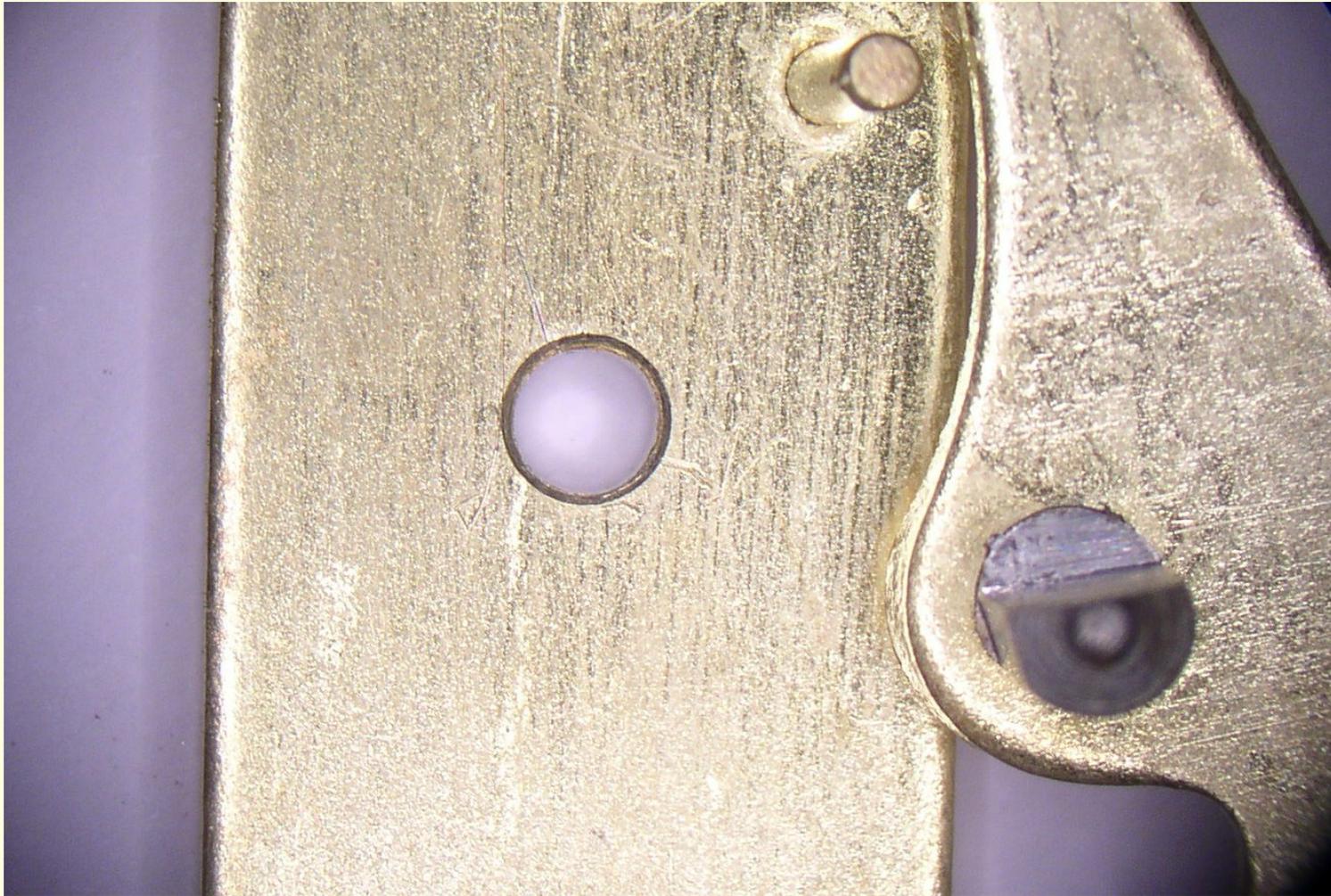


Bushing Second Wheel Front Hole

Close up

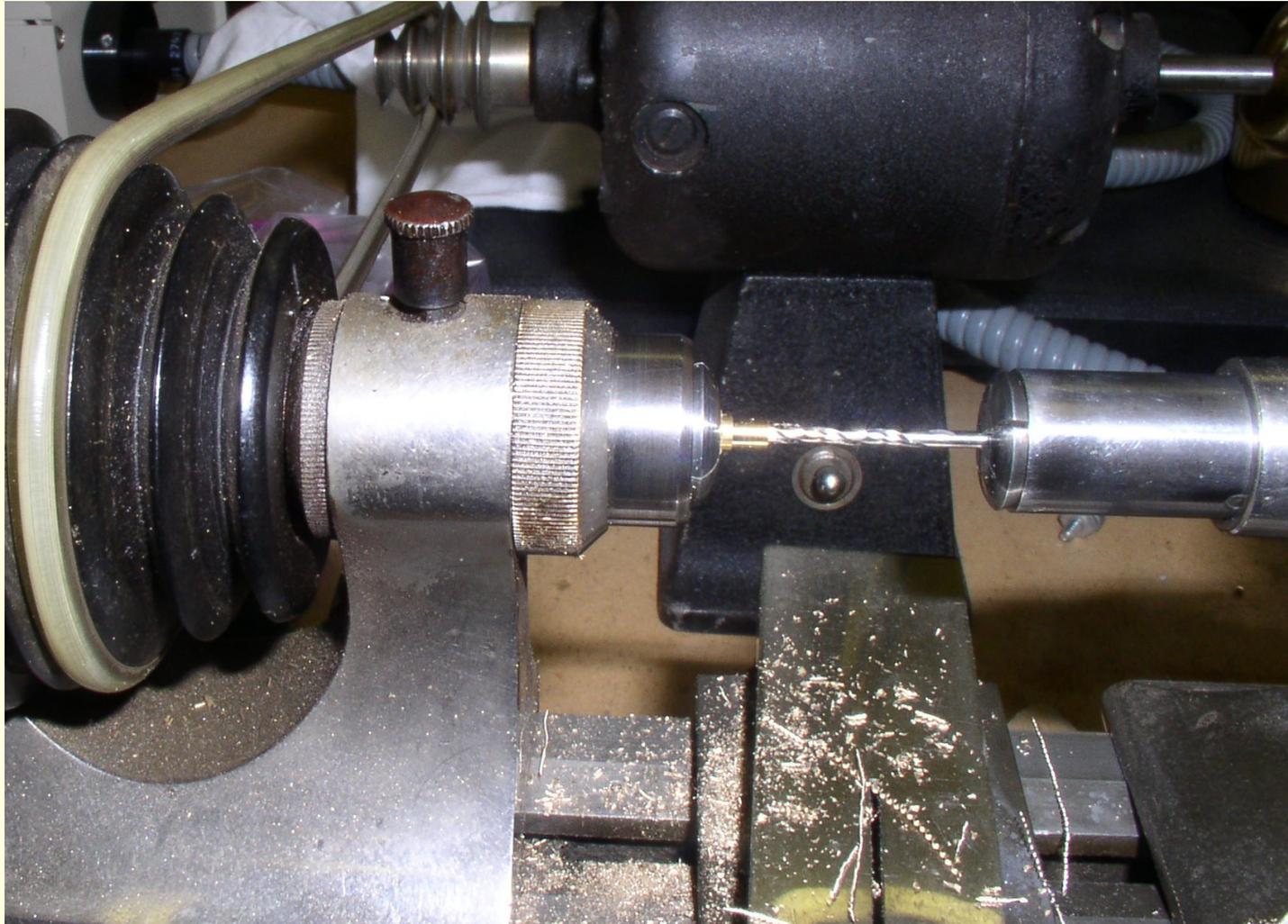


Hole Filed to Center and Broached



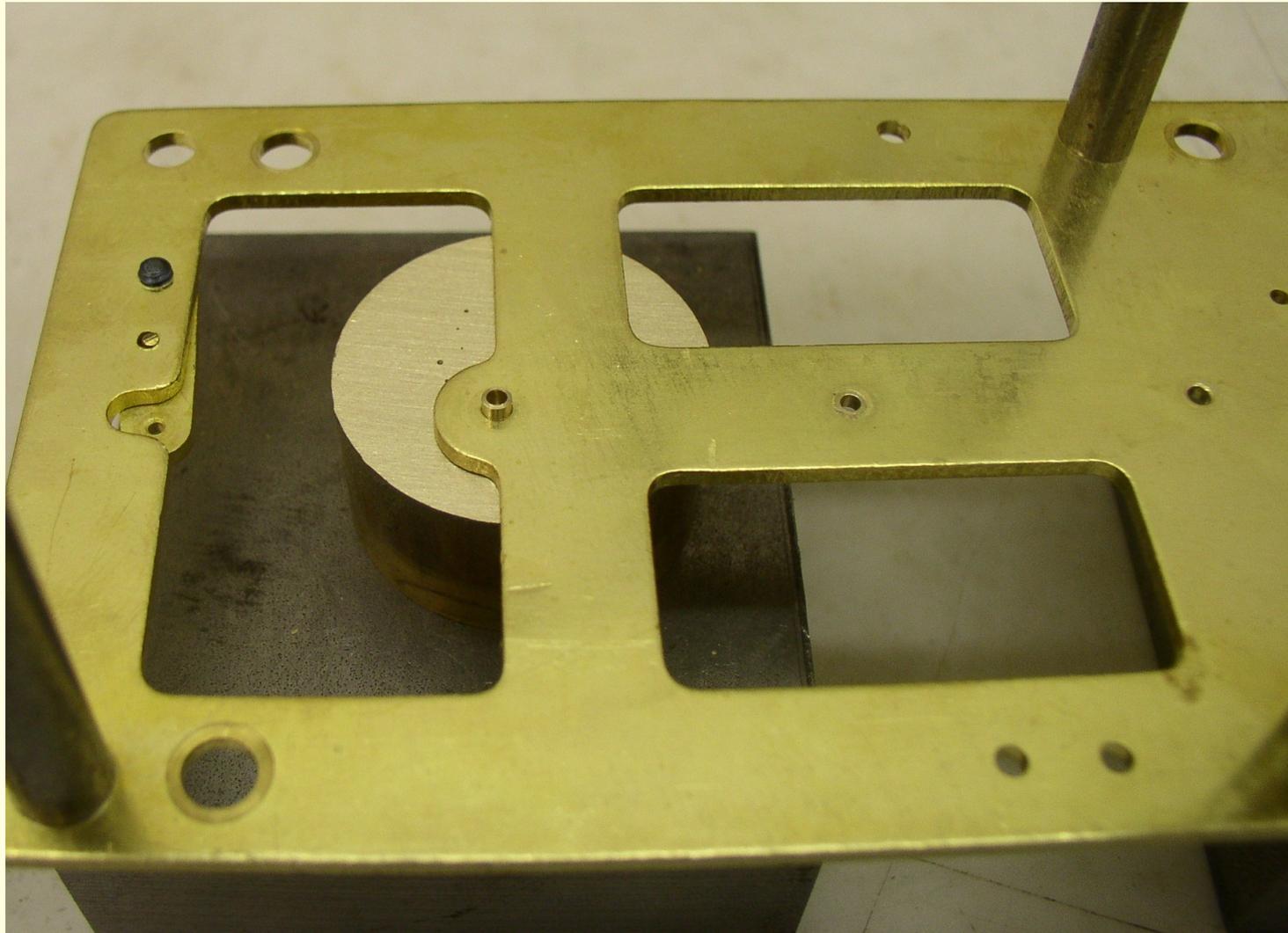
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Turning up Sleeve on Lathe



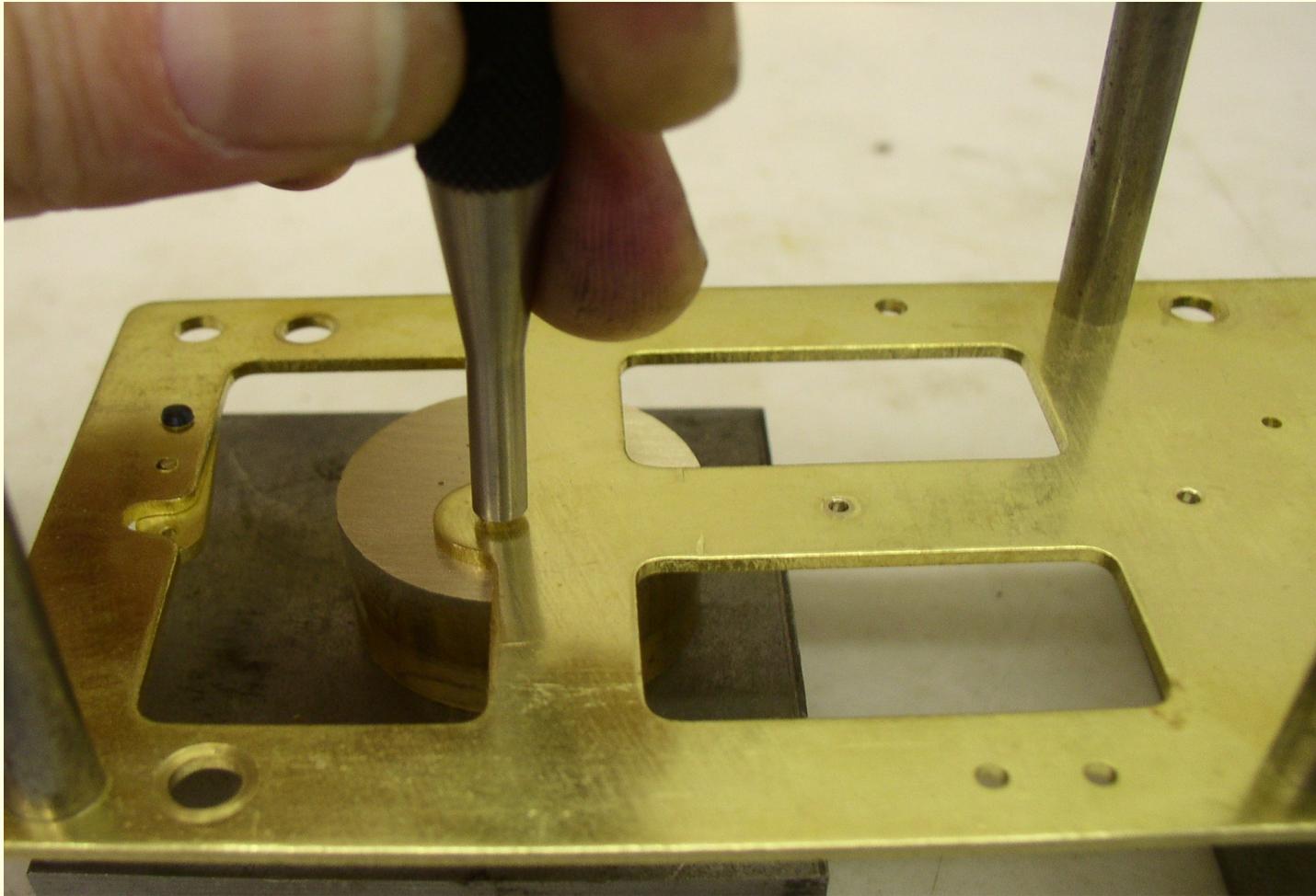
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Installing Sleeve



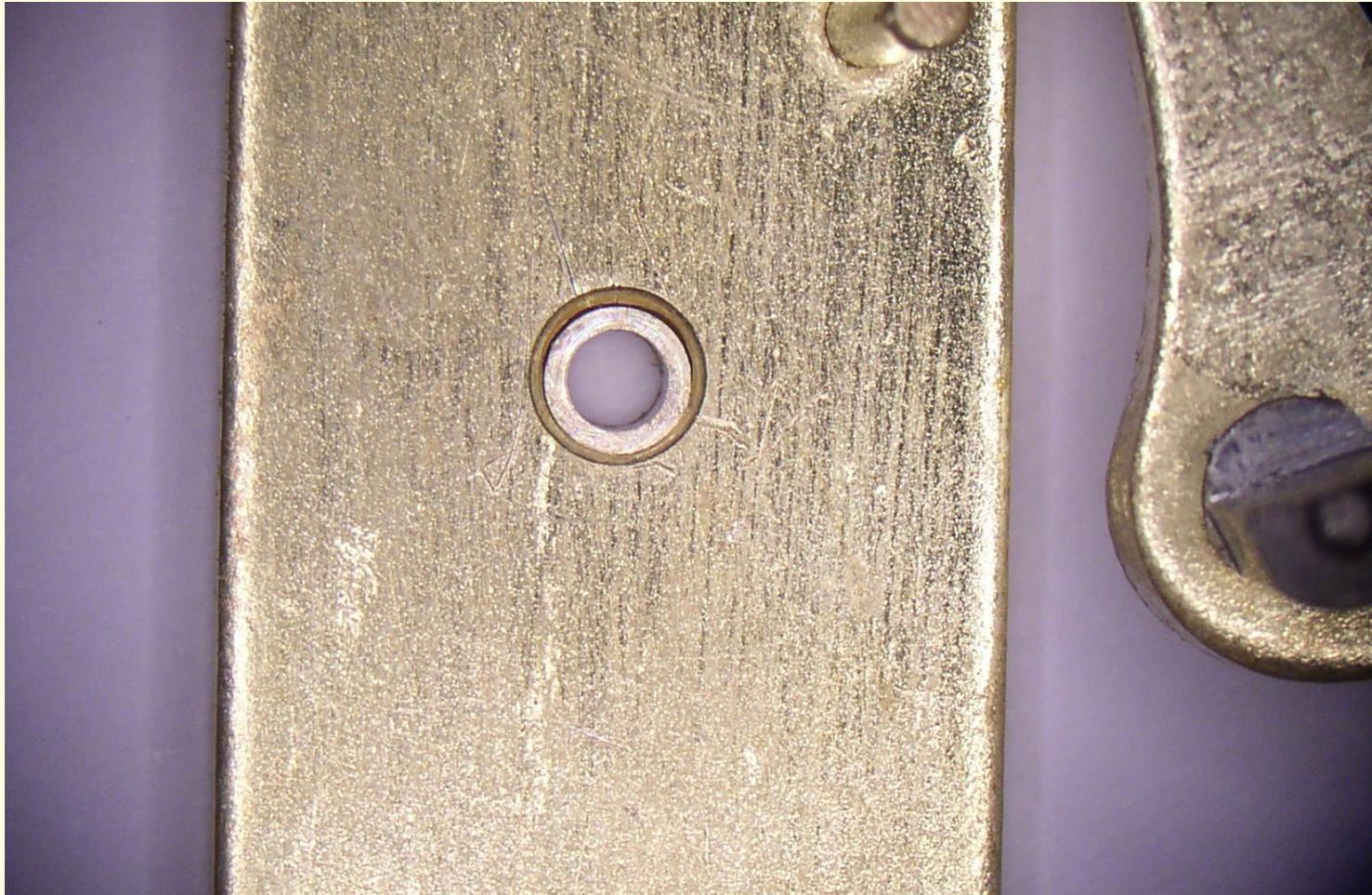
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Driving Home Sleeve

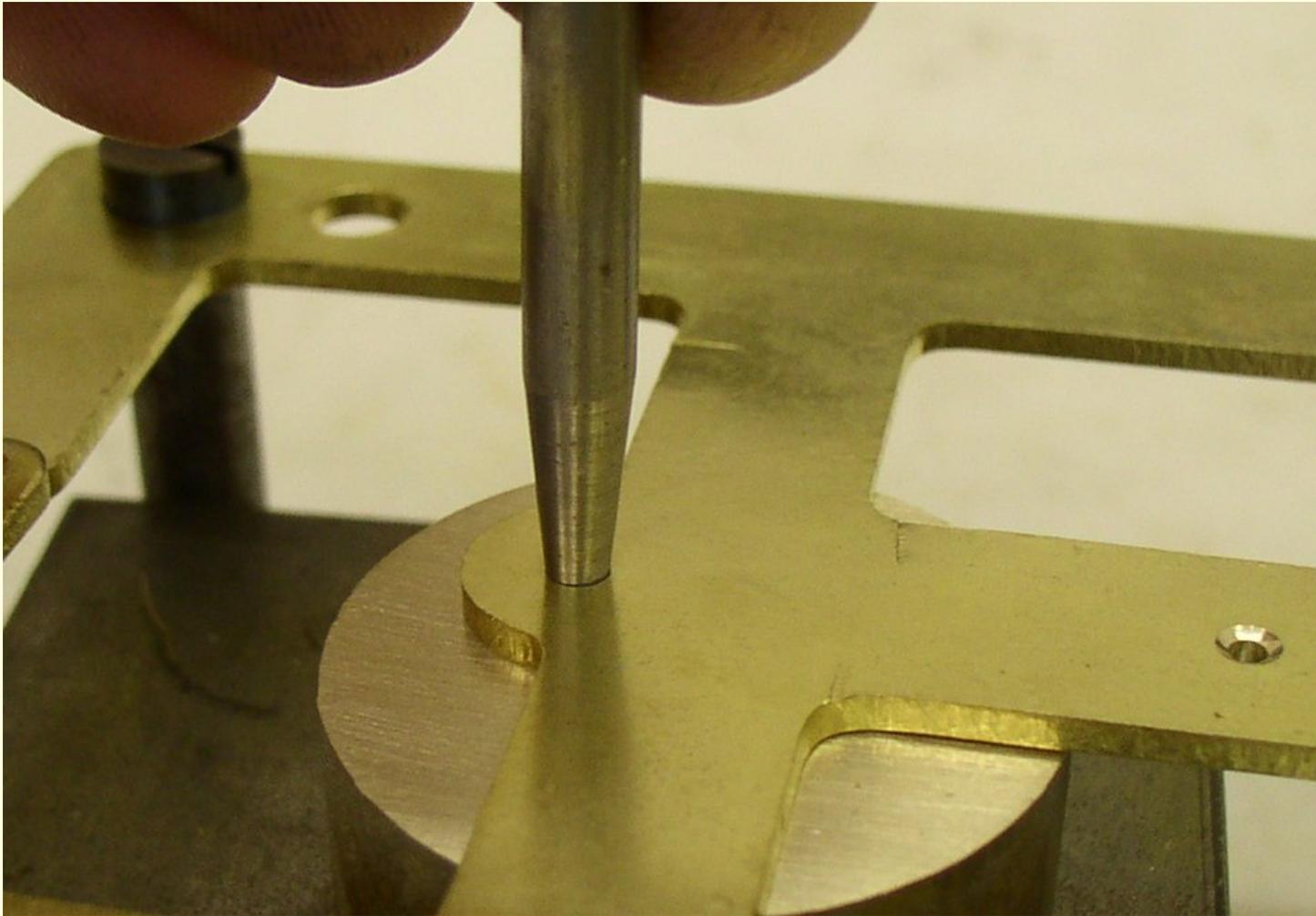


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Front View of Installed Sleeve

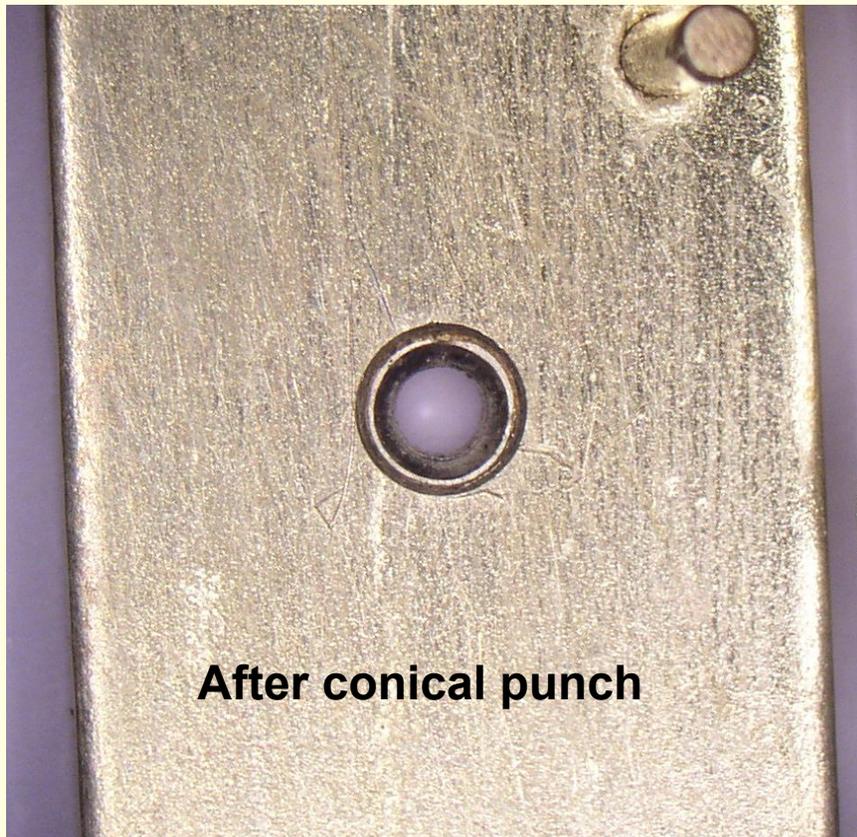


Shaping Oil Sink



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Finishing the Job

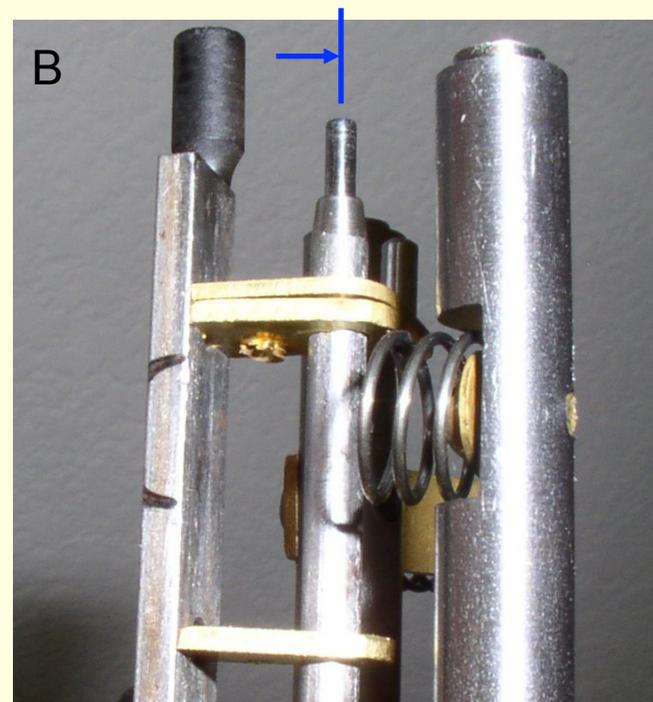
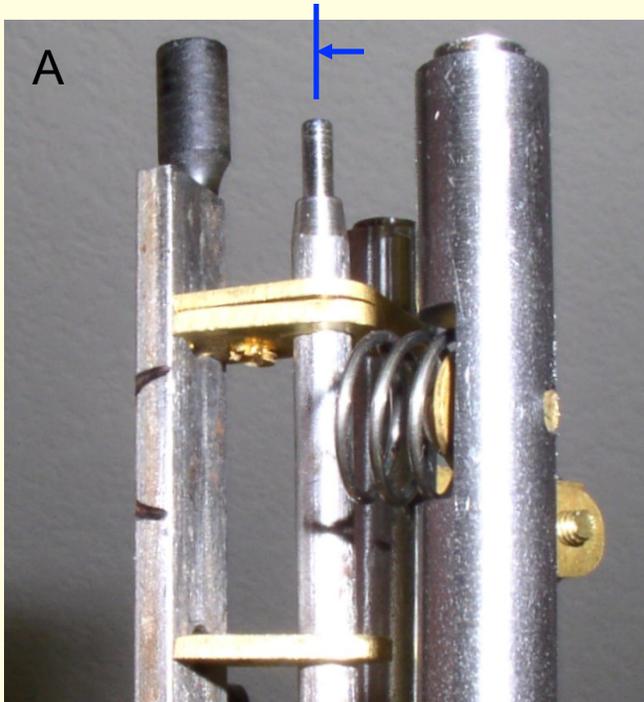


Another View of New Bushing



Motor Bearings

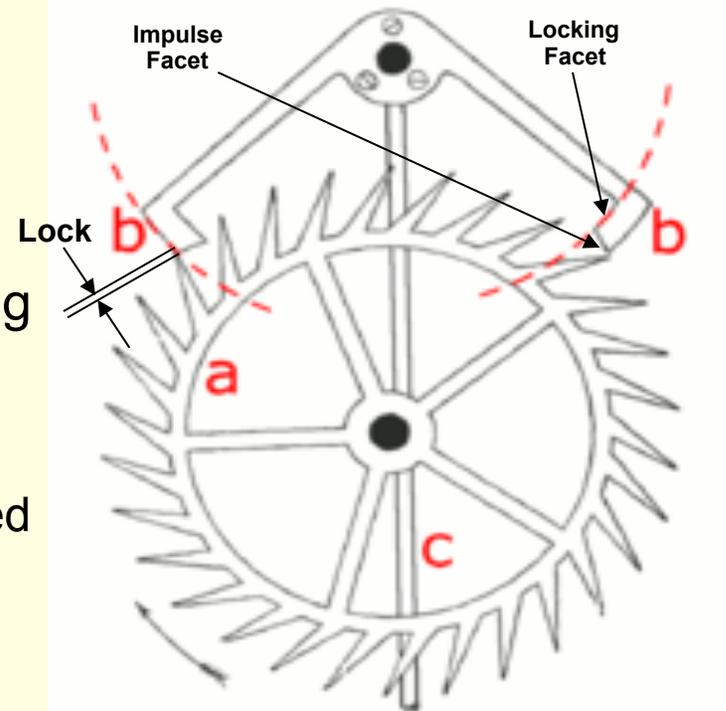
- Replace if side-to-side rock is greater than .125" total
 - Or if there is visible oval to hole
- Make bearings from .187" stock
- Rivet with conical punch or dapping tool



Graham Escapement

Graham Dead Beat Escapement

- Three important parameters:
 - Lock
 - Drop
 - Clearance
- Maintain proper lock & drop while achieving clearance from back of tooth to pallet
- How much lock?
 - Around .005” or slightly more recommended
 - **POSITIVE LOCK ONLY**
- How much drop?
 - More important that it is equal
 - Minimize if possible

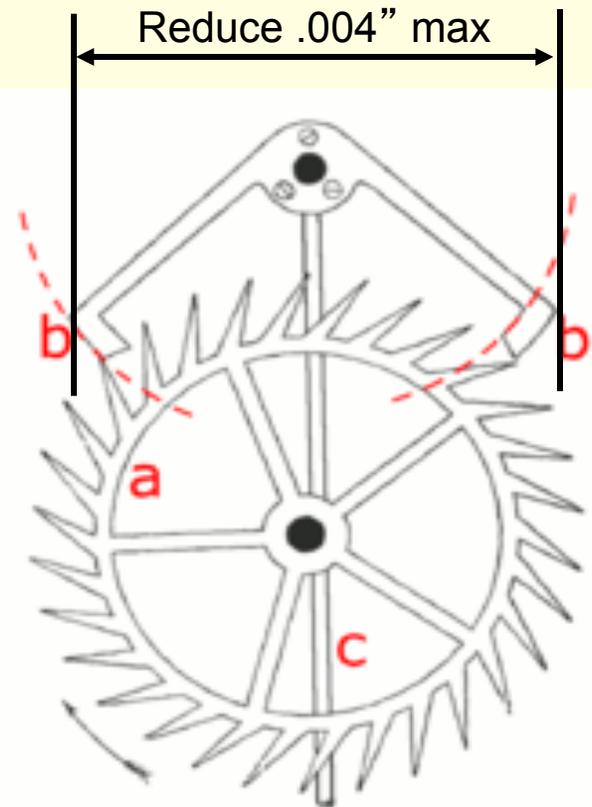


Considerations

- No adjustment till pallets, pivots polished, holes bushed
- Escape wheel must be true for low beat error
 - May have to top wheel (but no more than .005” diameter reduction)
 - Most escape wheels will already be undersize due to wear
 - Teeth straight
- SWCC pallets soft enough for MINOR span adjustments
 - Recommend heating arms if unsure
 - DO NOT try to bend cast pallets without heat!!
- Adjustments to pallet are geometric approximations
 - No practical alternative, and they do work
- **Under NO circumstances is negative lock ok!!**

Adjusting Grahams

1. Test escapement for lock and drop
2. Increase depth to increase lock
 - Adjust depthing until sufficient lock achieved (target .005")
 - If interference, close in pallets .002"
3. Reinstall pallet and repeat 2 until sufficient lock and drop
 - No more than .006" cumulative should be necessary (unless wheel severely worn)
4. Final check:
 - Equal drop
 - Lock approximately .005" (more ok if lead bob pendulum)
 - Beat error 5% or less is optimum

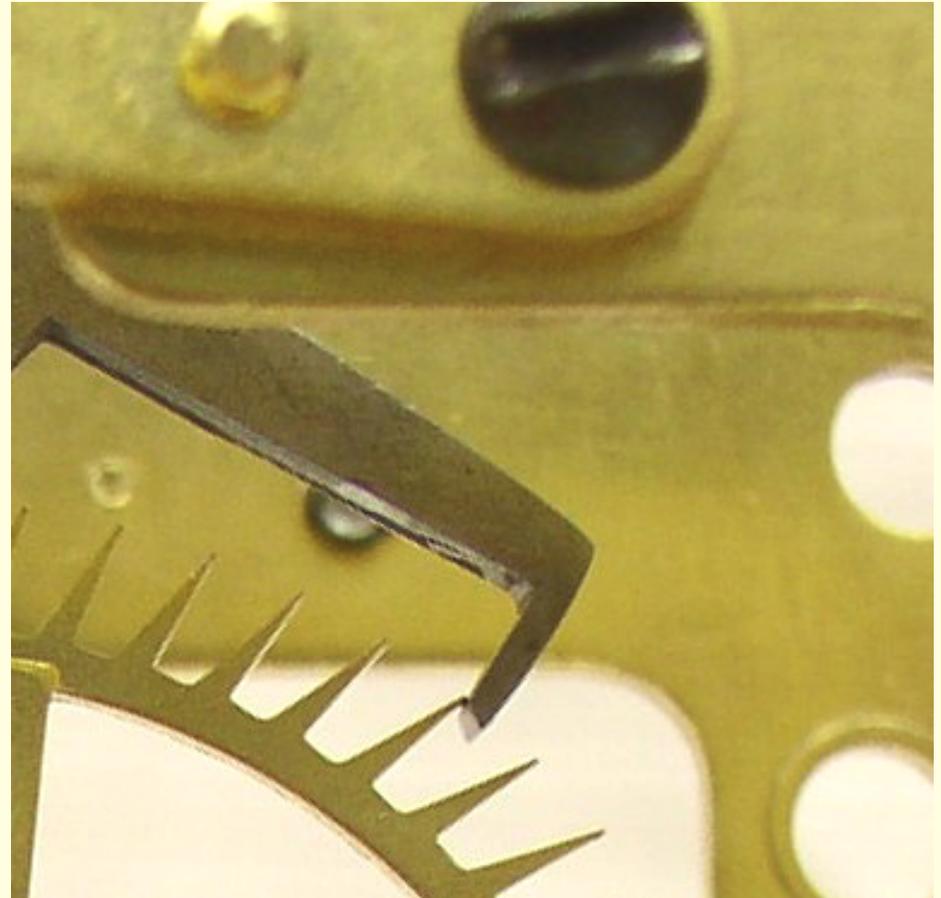


Example 120 Beat Graham

(175133)



Entry Pallet Lock



Exit Pallet Lock

Hard Chrome Brass Verges

- Watch out for hard chrome-plated brass verges
- Found on newer 120b Broadcast Studio models
 - Chrome will be worn through to brass
 - Polishing out will result in brass on brass
- Replace with tool steel verge
 - Or fabricate new one



Contacts

What makes a good contact material?

(For SWCC)

- Low contact resistance
 - With light contact force
- Resistant to oxidation and arcing
 - High melting temp and resilience to burning
 - Inert (does not grow oxide in normal environments)
- Good hardness—wears well over time

Contacts

- What kind of materials offer these qualities?

Material	Low Contact R (at low force)	Resistance to Surface Films	Hardness (wears well)
Gold	Better	Best	Poor
Platinum (Palladium)	Better	Best	Better (Platinum-Iridium best)
Silver	Best (initially)	Fair	Fair
Tungsten	Poor	Good	Best (resists burning also)
Copper	Best (initially)	Poor	Poor

Contacts

- Platinum is best
- Palladium suitable but lower melting temp
- Platinum-iridium most durable (alloy)
 - Great for motor contact pins
 - .025" Diameter
- EXPENSIVE
- Silver is an option (1/5 the cost of Platinum) but softer
 - Need thicker foil to get long life
 - More maintenance cleanings to remove oxides

Great source of precious metals:
<https://www.surepure.com/>

Buy Platinum Foil, Sheet, Plate, and Ribbon



Platinum sheet
0.025" thick x 2.00" x 2.00"



Platinum ribbon
0.001" thick x 0.025" wide

Standard thicknesses range from 0.002" to 0.128".

Available widths depend on the thickness.

We use the terms "**foil**," "**sheet**," and "**plate**" for shorter cut pieces (usually up to 12" long) that are usually supplied flat.

"**Foil**" is very thin;

"**Sheet**" is a little thicker and is thus a little stronger and bends less;

"**Plate**" is even thicker and is barely pliable.

We use the term "**ribbon**" for longer pieces that are usually supplied on a spool.

DeoxIT® and DeoxIT® Gold G100L

- Caig Laboratories
- Proven over 50 year history
- Unbelievable results
- Only a very small quantity needed on CLEAN contacts to preserve them
 - Don't flood contact with it



<https://caig.com>

Hourly Contactor Problem

175133

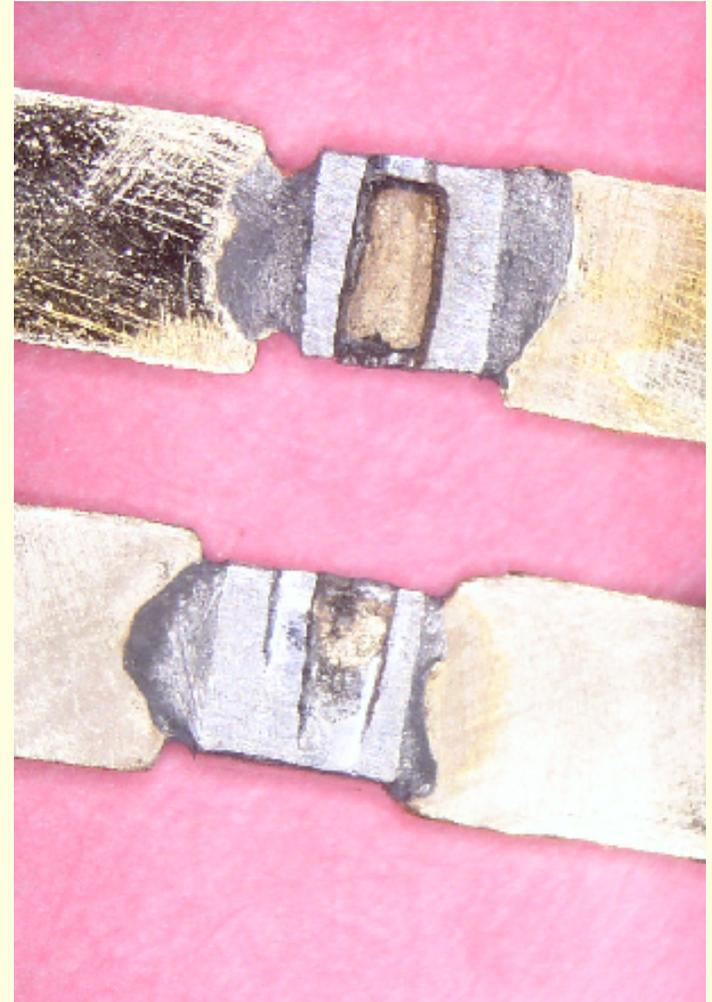
- Oxidized solder below Pt has higher resistance
- Finger contact has NO platinum, apparently removed previously
- Severe pitting caused by missing damping resistor



Motor Contacts and Pins

175133

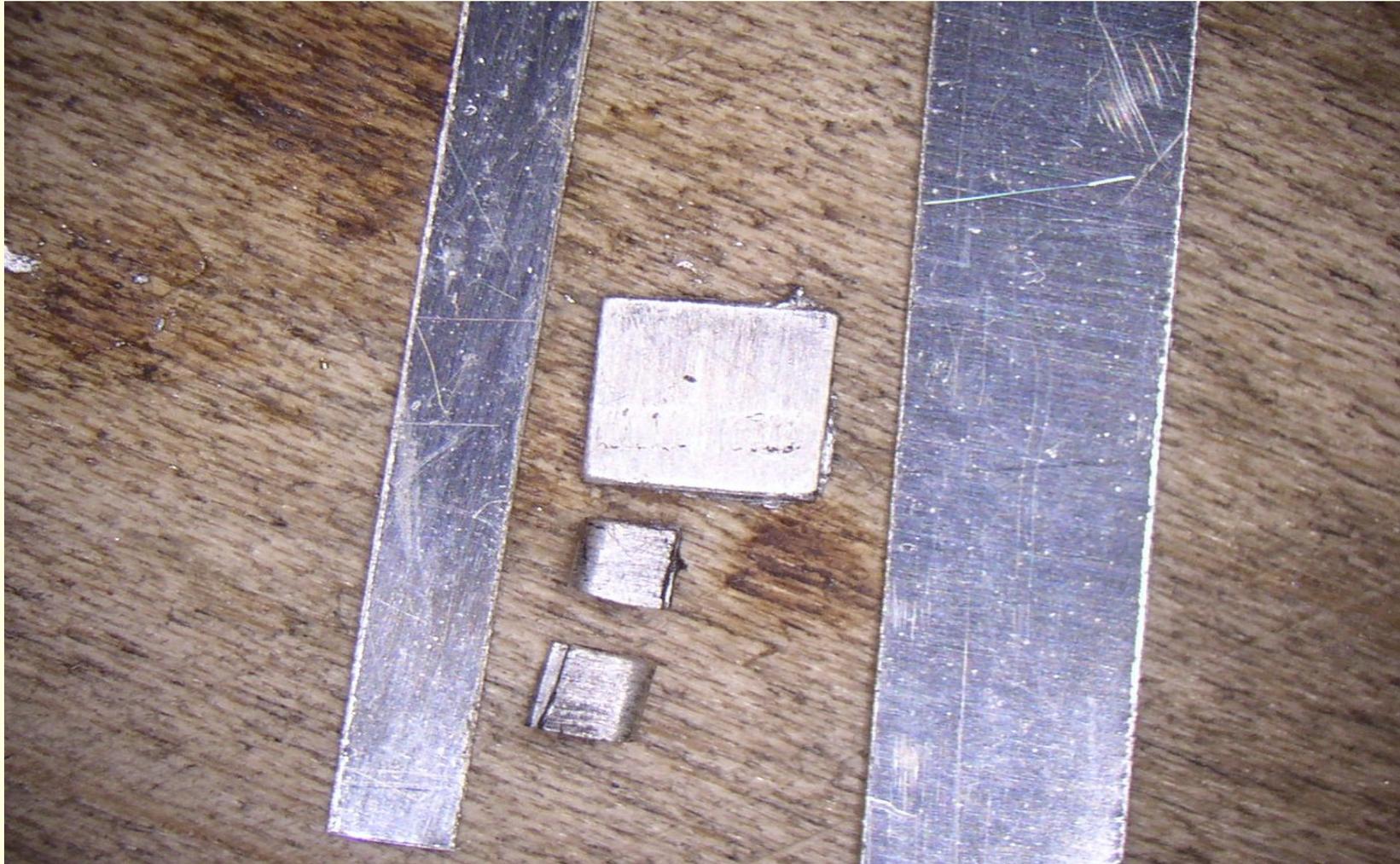
- Motor Spring Contacts
- Result of removing damping resistor



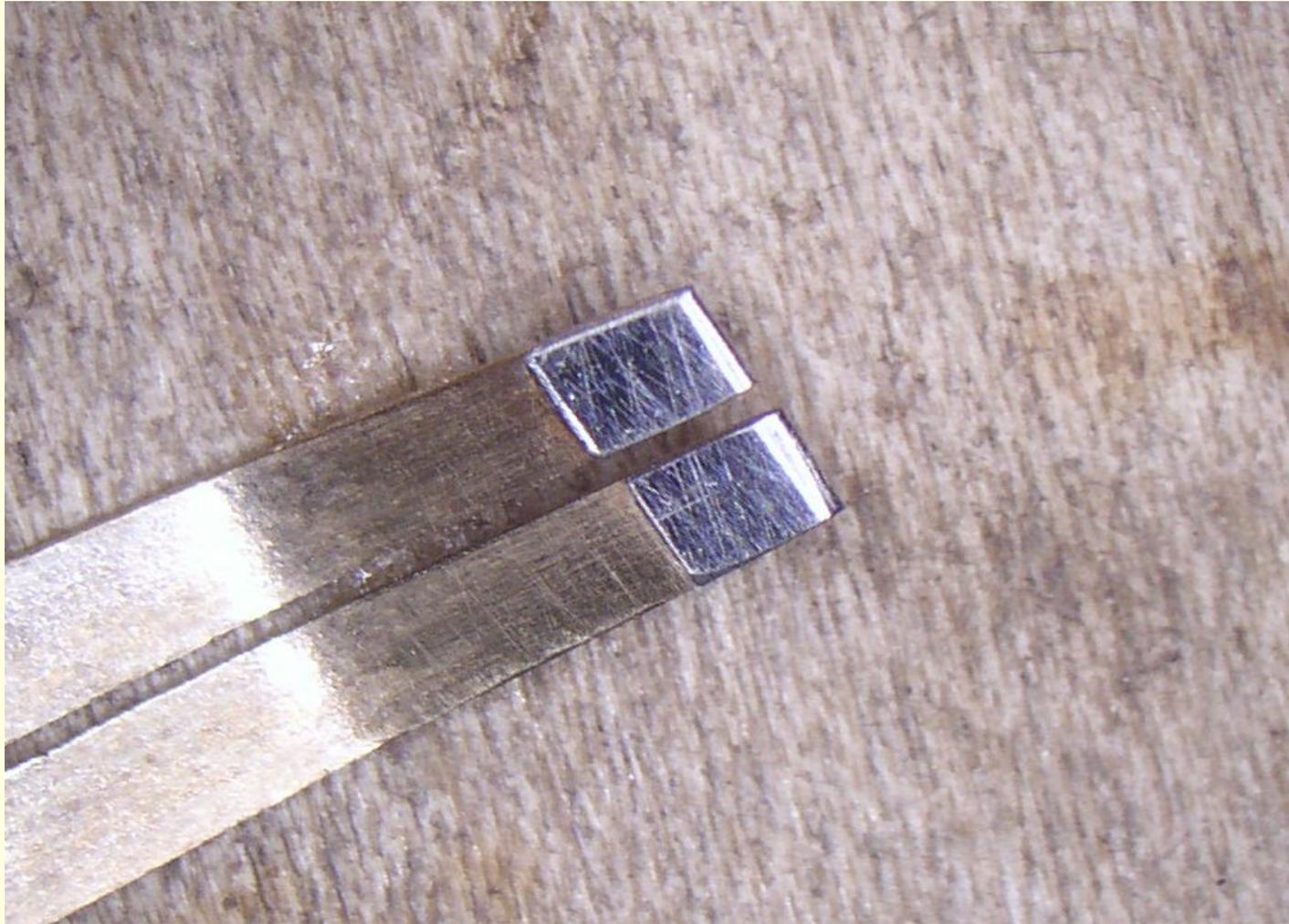
Example: Repairing Finger Contacts

- Procure Platinum sheet 0.004” thick
- Cut into strip 0.060” x 0.156”
- Fold onto end of contactor (in half)
- Apply neat coat of solder paste to base contact
 - Reinstall platinum
 - Don’t get any on platinum surface!
- Heat with hot air pencil
- Trim with small file and fine paper
 - Do NOT abrade working surface

Sizing the Platinum Strips



Repaired Hourly Contactor

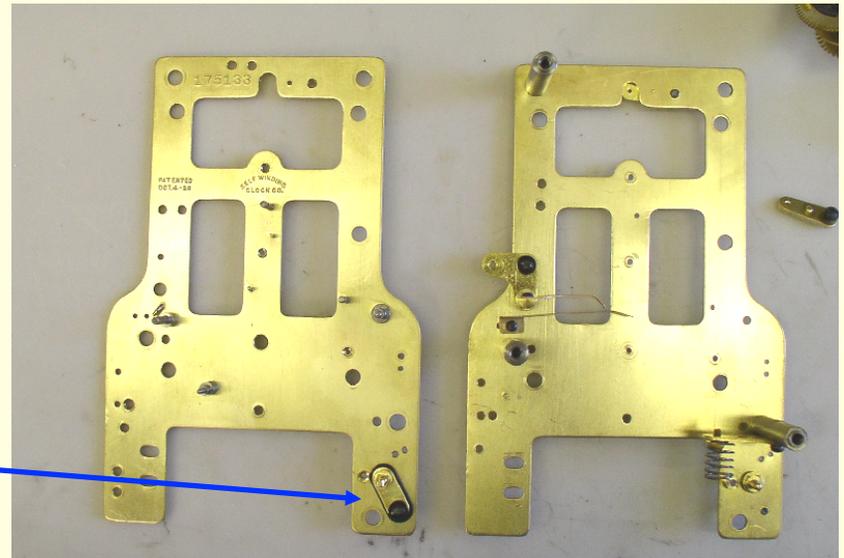


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Reassembly

Reassembly 1

- Install pillars
- Install Hourly Contact and motor spring contact studs
 - Larger shoulder insulators install in plates
 - Smaller ones install in accessories
 - Don't forget to install the flat insulators
 - Large hole insulators in motor contact studs
 - Motor contact mounts install flat up



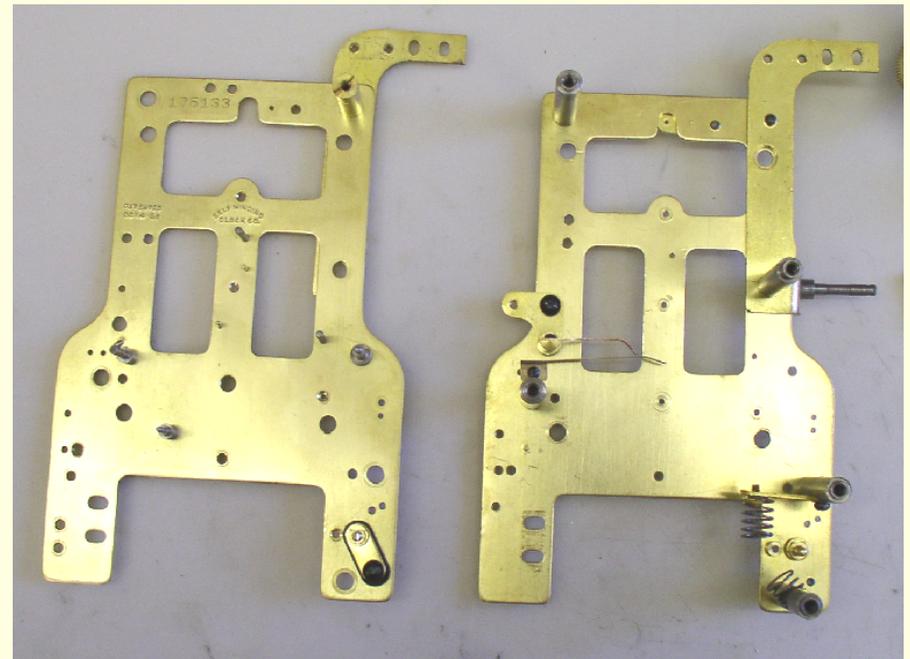
Broken or Missing Shoulder Washers

- Broken washers should be replaced
- Use 0.25" black Acetal (Delrin)
- Readily available from:
 - www.onlinemetals.com
 - www.interstateplastics.com
 - Costs about \$.70/ft and works well
- Procure kits on our website



Reassembly 2

- Install front and rear synchronizer extension
 - Remember shoulder screws and spacer



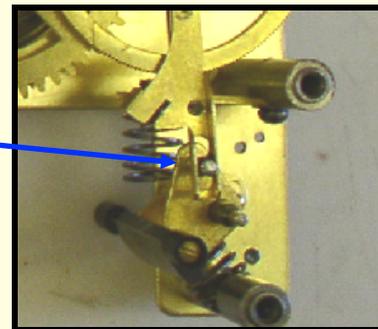
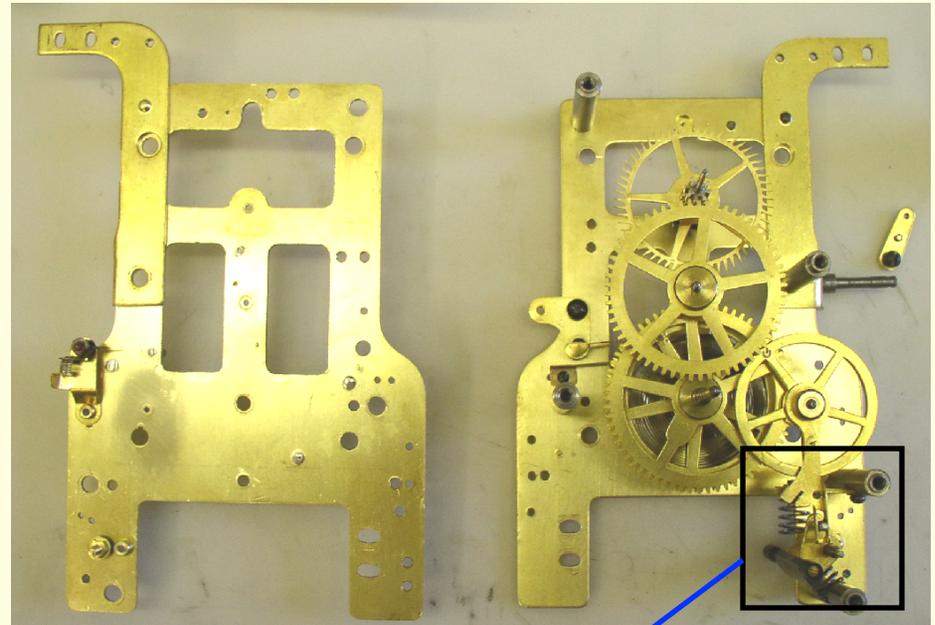
Correct Mainspring Tension

- Wind up 4 turns
 - 4 for lead pendulum bob models (.008" spring)
 - 3-4 for large mercurial models (.010" spring)
- Install knock away sector and winding cam
- Put a LIGHT smear of oil on cam surface



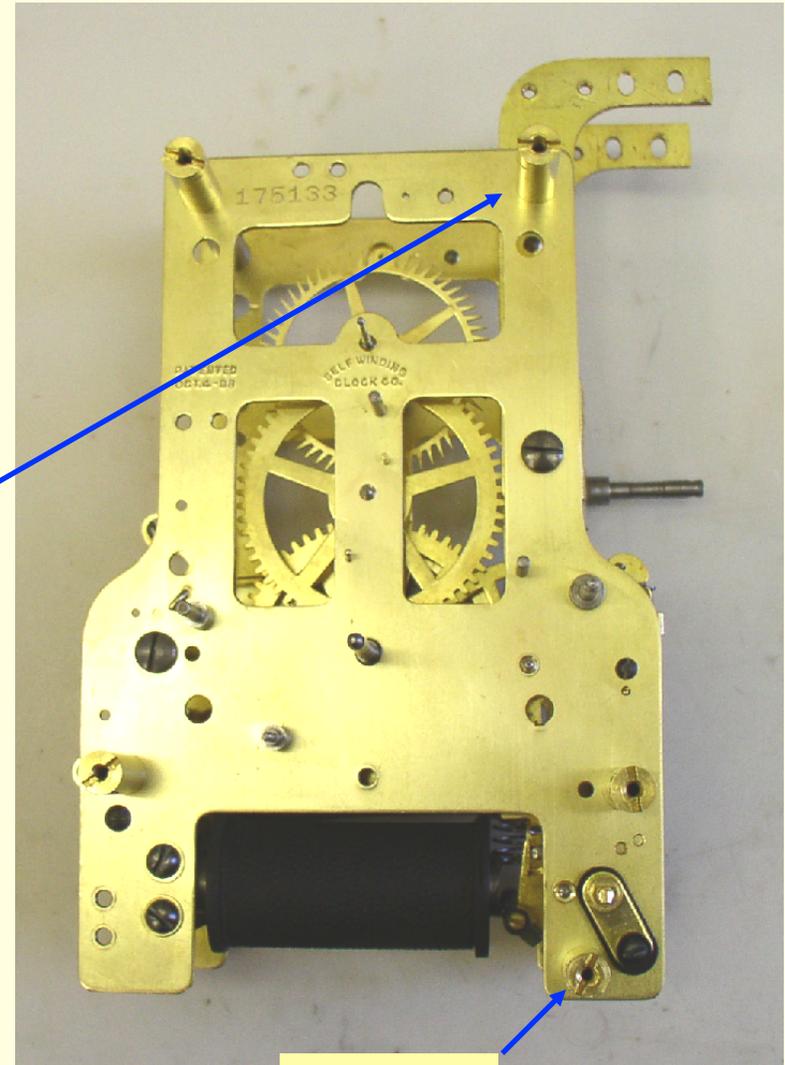
Reassembly 3

- Install Wheels
 - Main wheel first
- Drop of oil on each pivot before installing
- Install Winding Lever
 - Oil arbor pivot!!
- Install armature
 - Grease pin/slot
 - Super Lube grease



Reassembly 4

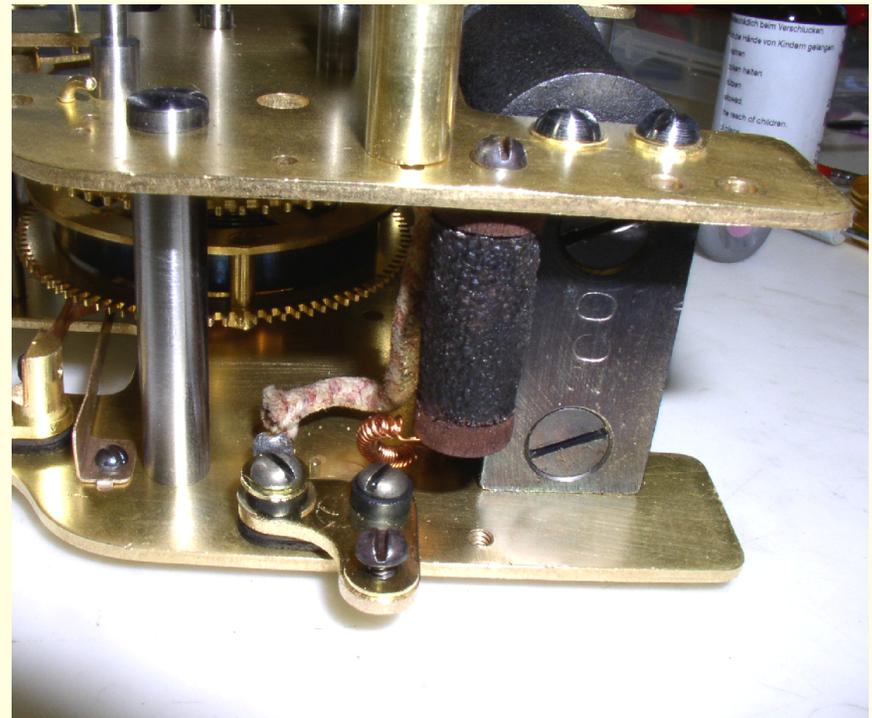
- Install top plate
 - Check end shake on all wheels
- Install pillar screws and spacers
 - Shoulder spacer
- Install motor coil
 - Washers under screws
 - Do not tighten yet



Short spacer

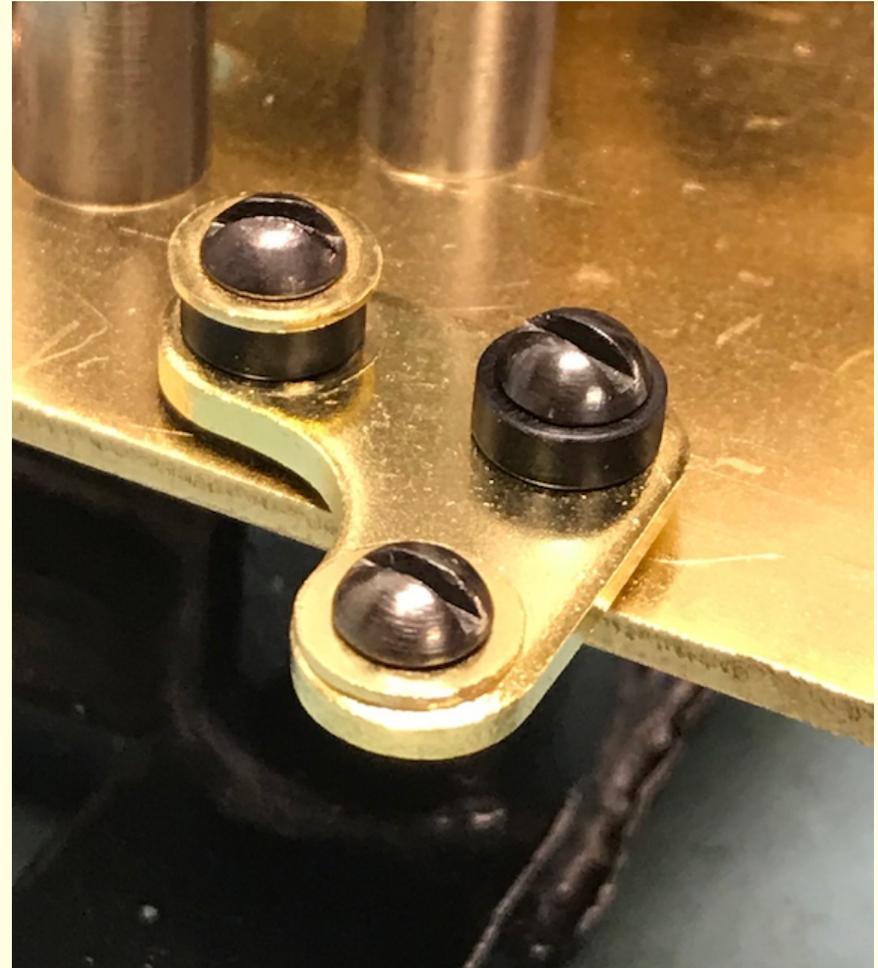
Reassembly 5

- Install resistor
- Install lower terminal
 - Insulator under assembly
 - Brass washer under upper shoulder spacer
 - Coil spade lug under shoulder insulator
 - NO brass washer under lower shoulder insulator
- Install terminal screw and brass washer



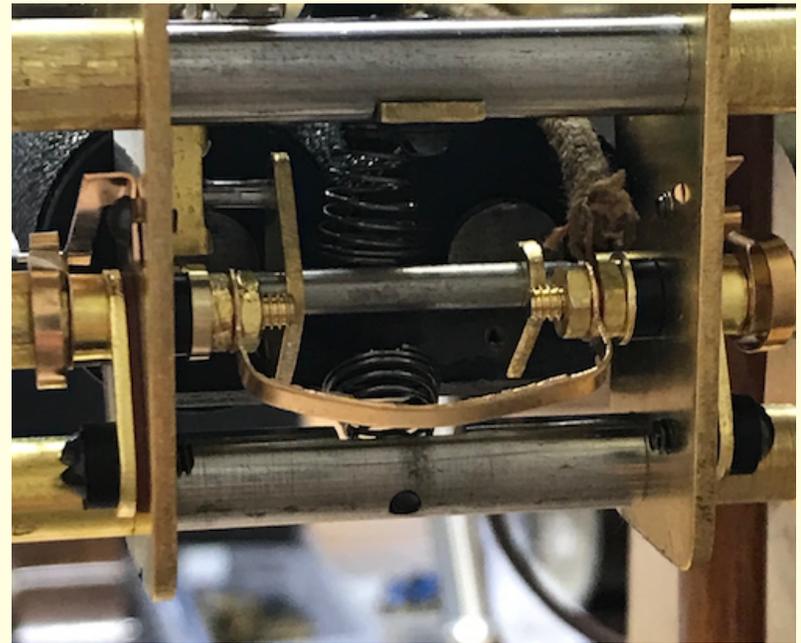
Notes on Terminal Assembly

- Brass washers over insulators where lugs are fastened
- Screws/washers used to hold down wires. Wire under washer, wrapped clockwise around screw.
- Insulator under terminal
- This goes for ALL terminals on SWCC



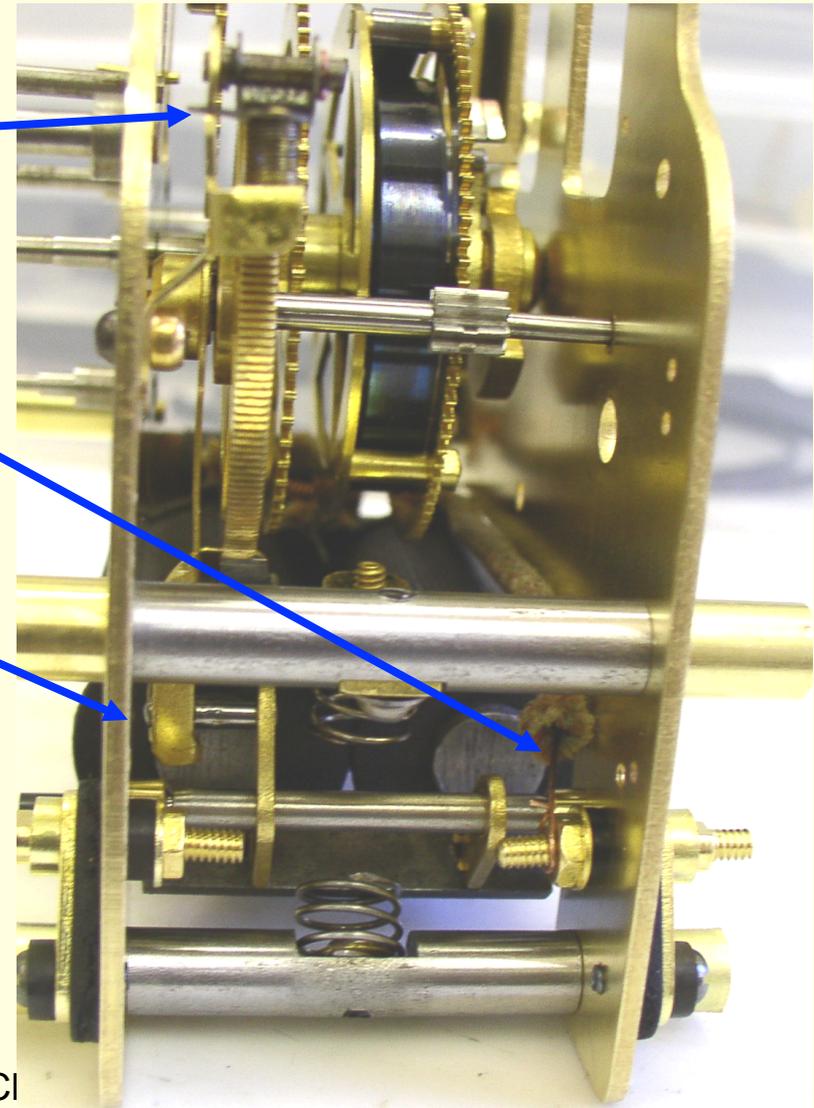
Correct Coil Connections

- Lug to upper screw/washer of left bottom terminal
- Upper wire to left side terminal
- Lower wire to right side of movement, to rear contact stud. Be sure bridge is in place!
- Lug contacts terminal, NOT washer



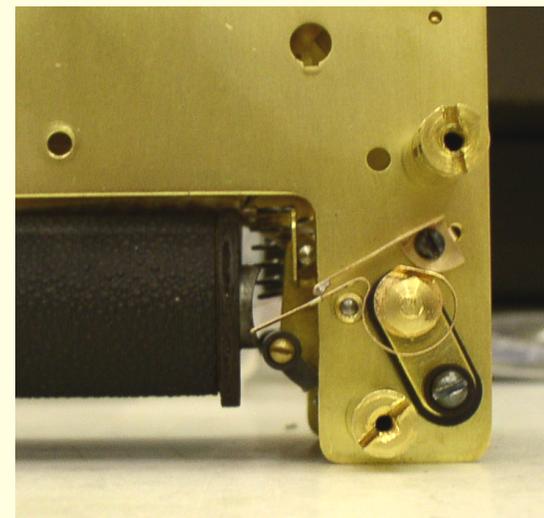
Reassembly 6

- Adjust upper ratchet pawl
- Loop coil lead wire around rear contact stud, clockwise
- Make sure armature pin clears plate
 - Bend winding arm if needed



Reassembly 7

- Install motor contacts
 - Adjust until the spring contact points to center of coil yoke →
 - Pin in center of platinum pad
 - When spring placed underneath pin, it clears by .04”



Motor Tune Up

Winding Motor Tune-Up

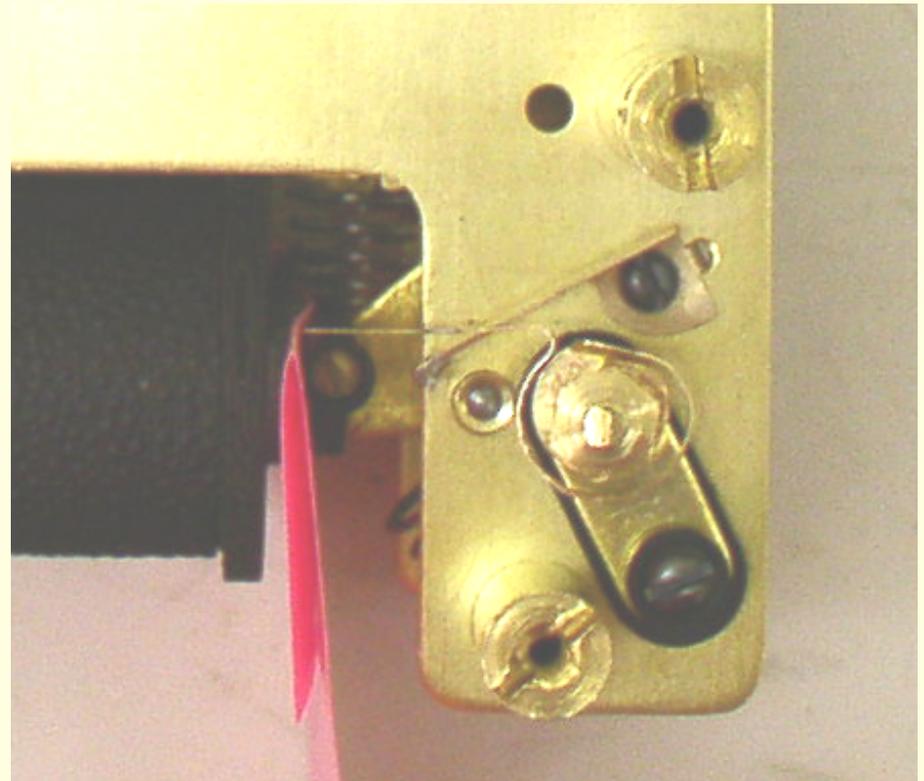
- Benefits:
 - Optimize motor efficiency
 - Best battery life
 - Quieter, faster wind
- Measure:
 - Winding time between 6 and 15 seconds
 - Will depend on mainspring tension and battery voltage—so use fresh batteries or Model 1900G or 1900R3
- ALL adjustments are important; don't skip steps!!

The Process

1. Adjust Coil Yoke position
 - Look to minimize gap: Shoot for .01-.015” minimum gap with full armature swing
2. Set motor contact spring to point at center of coil yoke
 - Adjust so pin is at center of pad
 - Adjust so BOTH contacts open at same time
3. Set contact spring tension by moving spring to lower side of pin
 - Should be about .040” under pin at this point
4. Adjust upper banking spring so that it contacts armature .062” after the contact disconnects
5. Adjust lower banking spring so the upper tip of the armature aligns with the bottom of the coil yoke

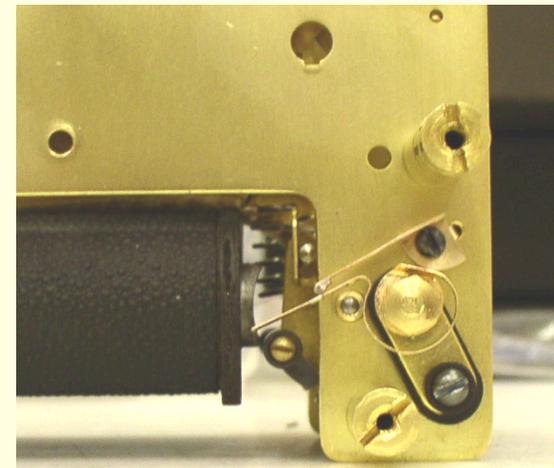
1. Adjusting Coil Yoke Position

- Common practice is to gap yoke to armature with 2-4 thickness of paper
 - Align armature to yoke as shown
- While in position tighten upper screws
- Repeat with movement flipped over. Tighten two rear screws.
- Check and double check gap when done

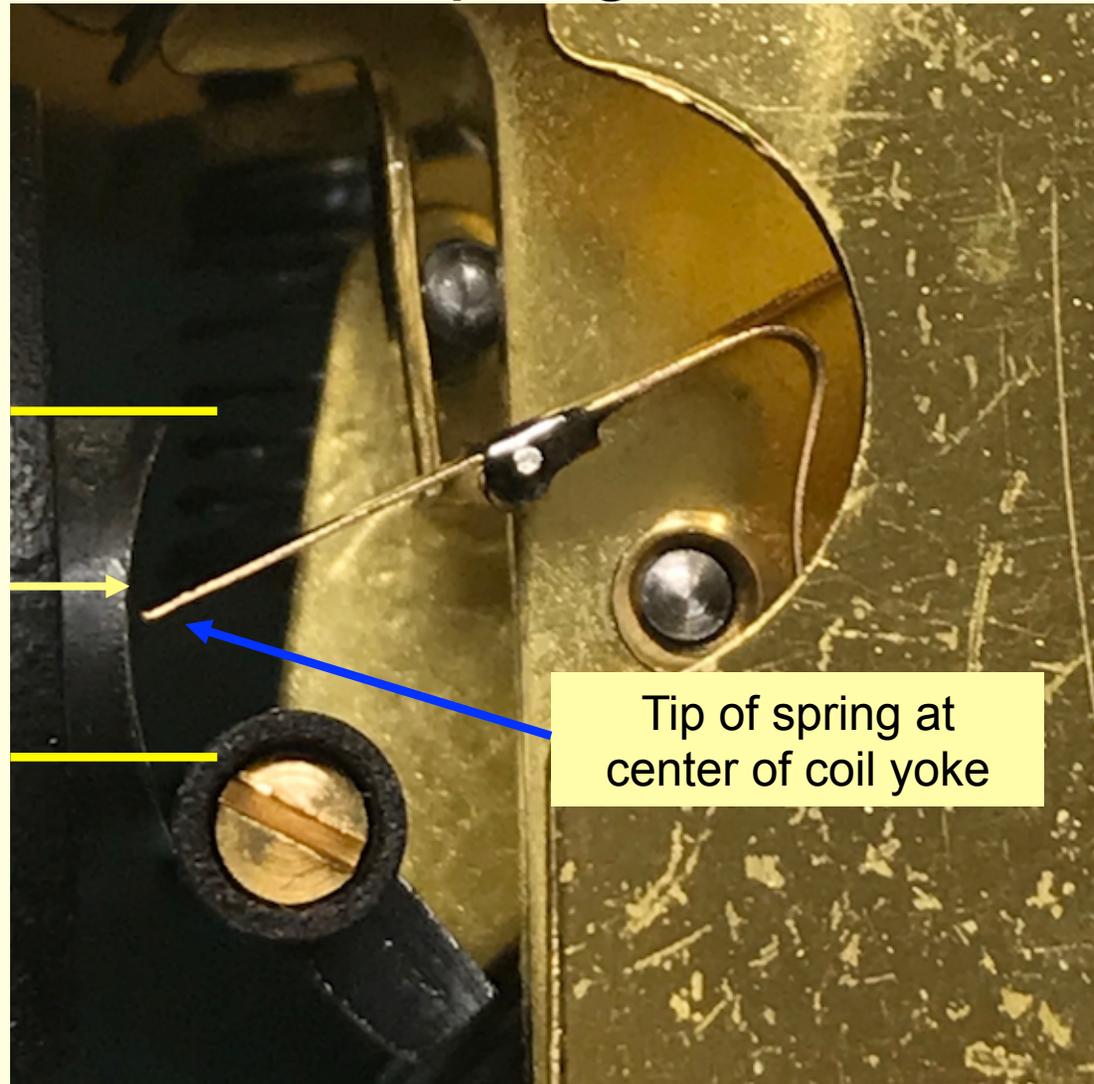


2. Set Spring Contact to Yoke Center

- Both front and Back contacts to yoke center
- When contact is lifted and dropped under pin, adjust to 0.04".
 - This will provide sufficient contact force with contact at rest



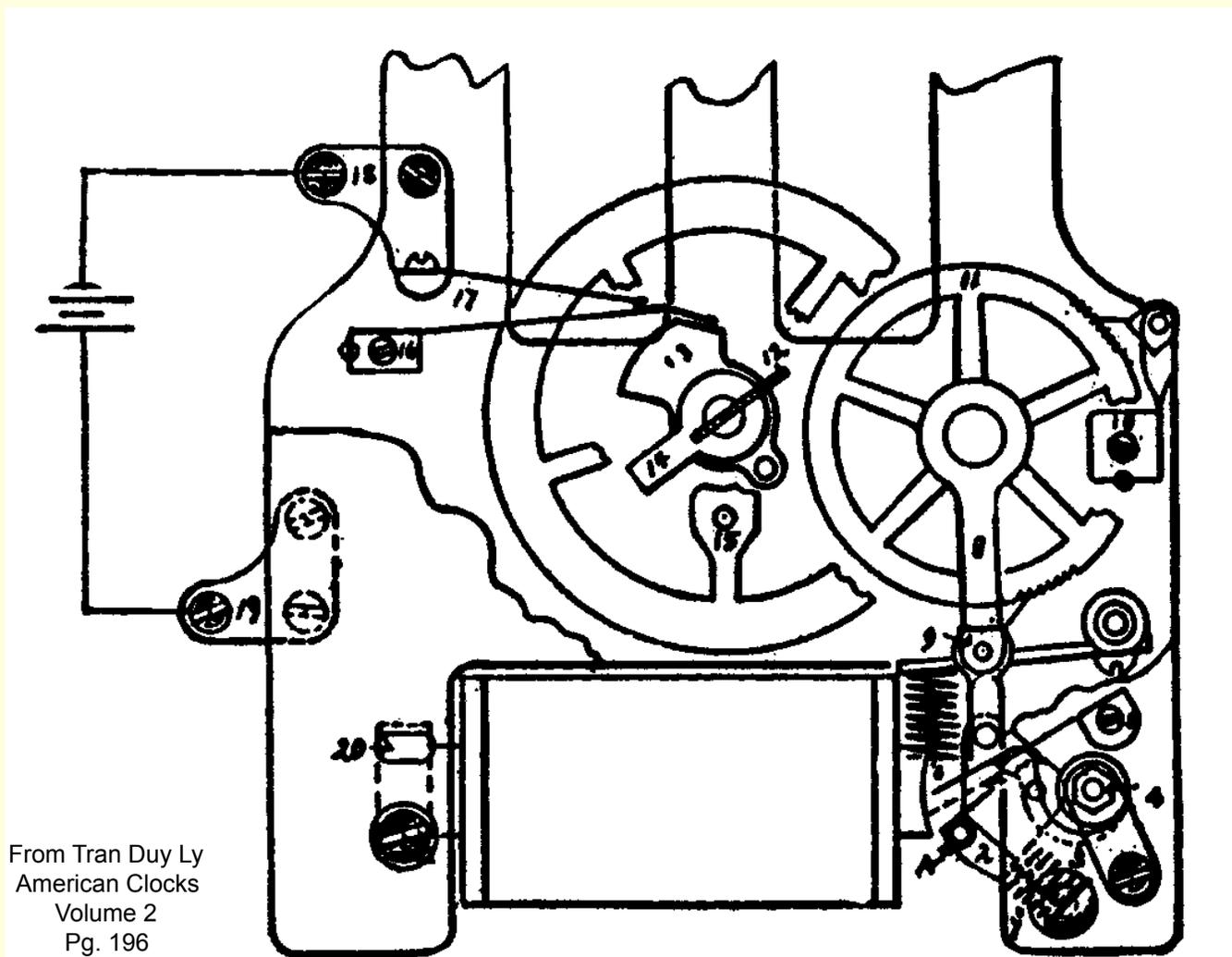
Proper Adjustment: Motor Spring Contact



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Setting Hourly Contactor and Banking Springs

Motor Diagram and Detail

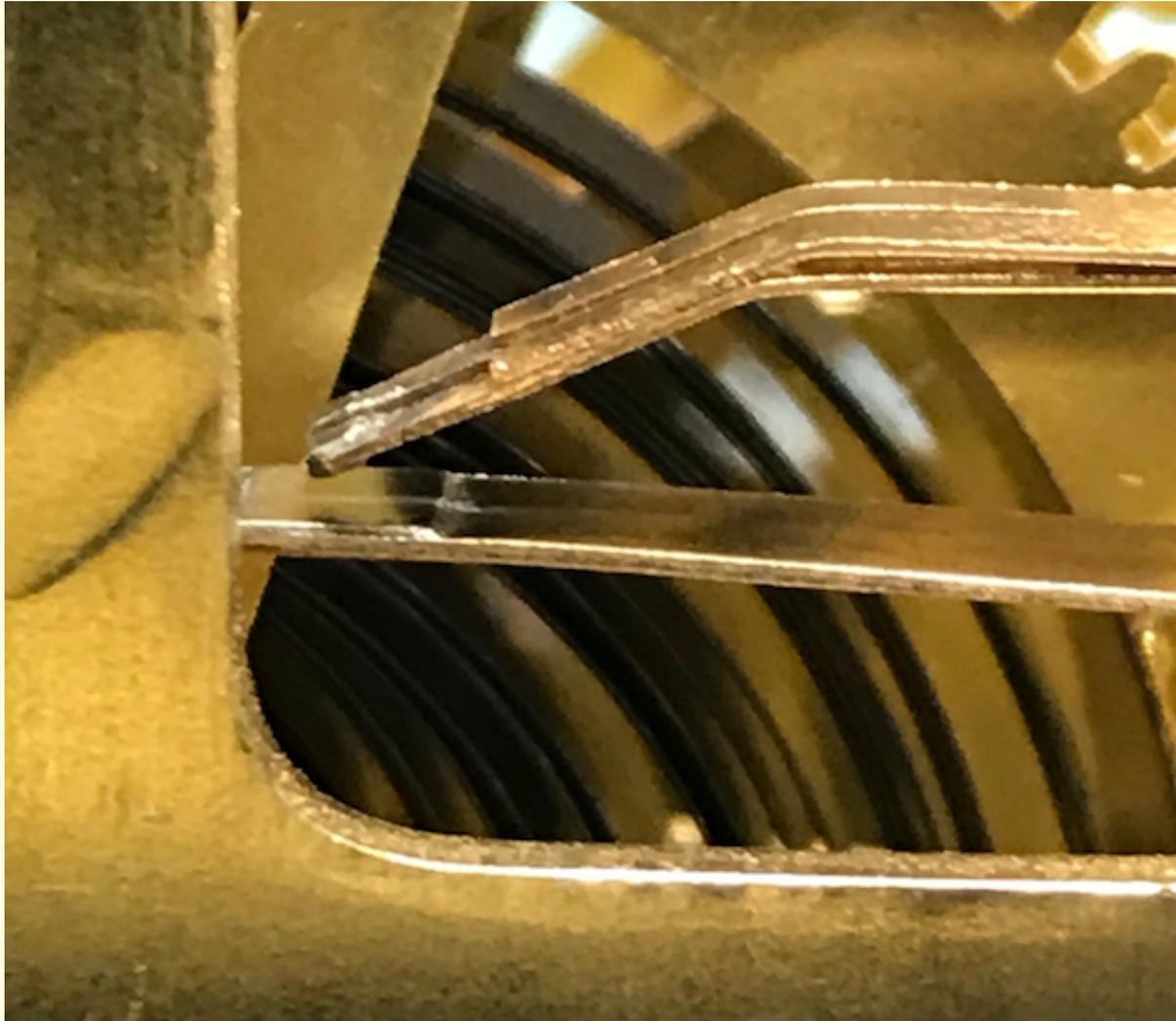


From Tran Duy Ly
American Clocks
Volume 2
Pg. 196

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Close-up of Hourly Contactor

Gap to .04" (1mm)



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Testing Self Winding Function

- Carefully remove verge
- Use finger to slowly let down escape wheel
- As hourly contactor comes up cam, slow down rate of release
- Stop escape wheel when winding starts; observe how the clock winds
- 8-12 seconds is good; 15 seconds “ok”

Testing Winding Efficiency

1. Connect battery to upper and lower contacts
2. With verge removed, turn center wheel until winding starts.
 - Hold escape wheel during wind
 - Allow to wind until it stops
3. Release escape wheel until hourly contactor just engages.
4. Time winding.
 - 6-9 seconds excellent
 - 9-12 seconds very good
 - 12-15 seconds acceptable (very good with .01" mainspring)
 - >15 seconds unacceptable

Completing Assembly

- Reinstall motion works
 - Do not forget to install star tension spring
- Check movement visually
- Touch up oil
- Test run

Synchronizing Components

- Don't remove them
 - Destroys the heritage (and value) of the clock
 - They can be put back in service
- Many SWCC models are only fair timekeepers w/o synchronization
- We have 1900GS Kit that will power and synchronize your clock to seconds/month
 - Looks like a pair of No. 6 cells
- Future class on restoring and adjusting them

