



WEST DEAN  
COLLEGE



# YEAR 1 CLOCK CONSTRUCTION

*Jon Colombo. June 2014.*





This document presents work undertaken in the second part of the first year of the West Dean 2 year Diploma in Conservation and Restoration of Clocks.

It covers highlights from the design and manufacture of an eighteenth century style Hoop and Spur clock completed as a part of the first year of that course.

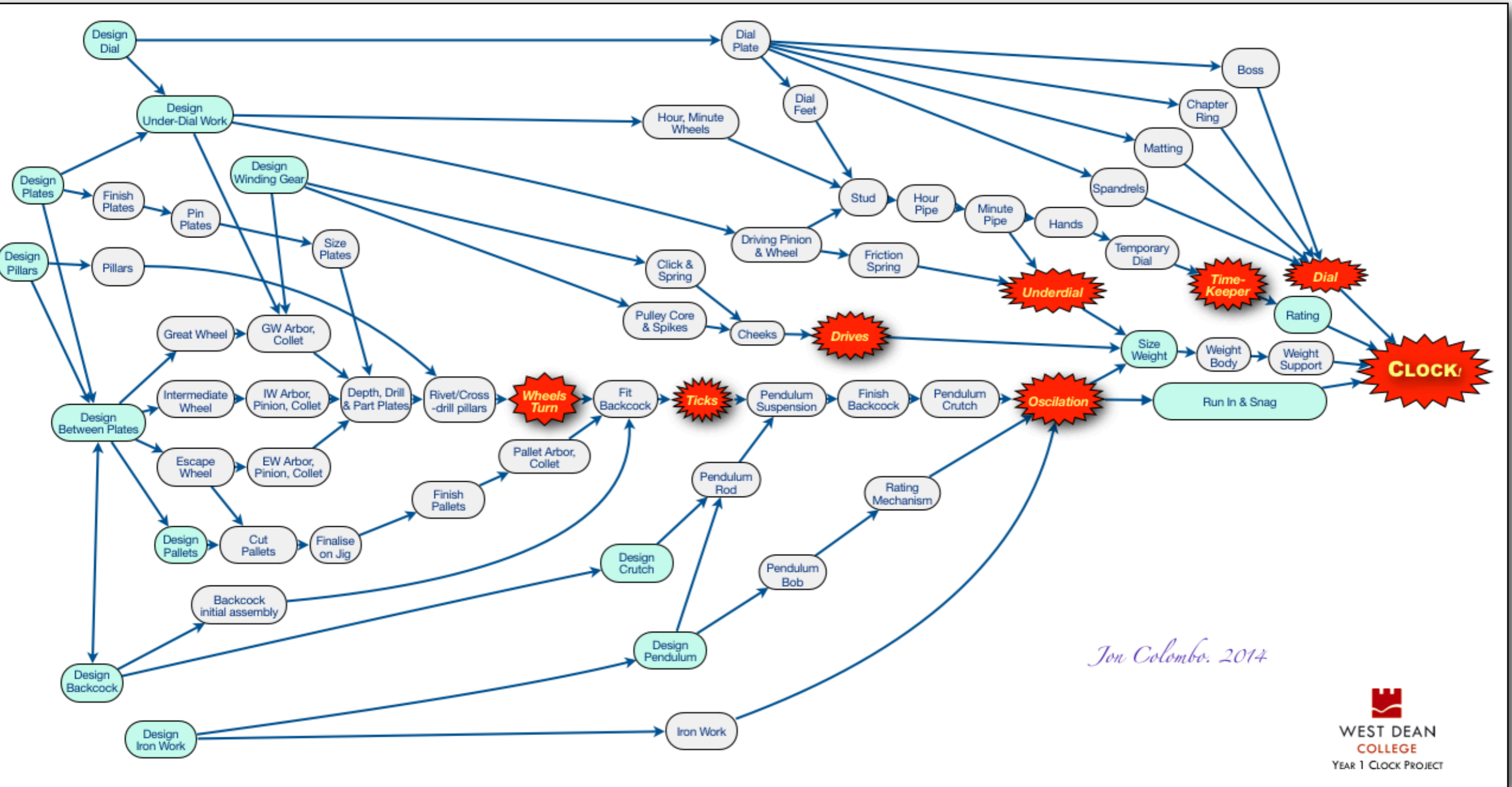
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# Clock Production Process Flow

For the manufacture of a single-train Hoop and Spur clock.



# Chapter Ring

Task: Manufacture chapter ring, engrave, and silver.



Chapter Ring

## Work:

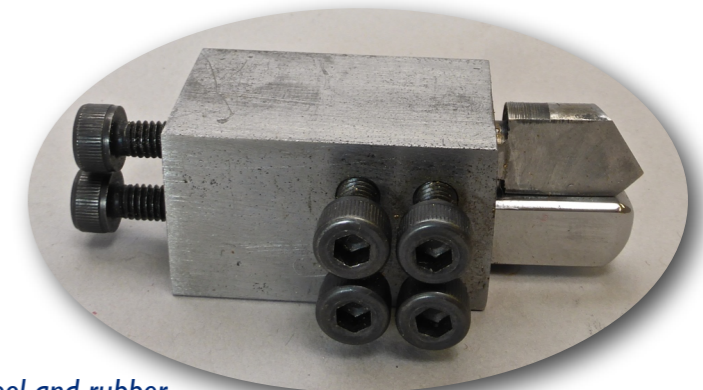
- *Design/Planning* - produce scale drawing on computer with cut-lines. Invert. Design cutting tool/rubber and work out how to mount on lathe.
- *Cutting tool* - make mild steel block, drill holes for tools and hex screw adjusters, tap these. Cut and shape rubber and cutting tool from silver steel. Harden/Temper.
- *Blanks* - cut stack of brass blanks on mandrel (allows for prototyping). Separate. Drill, make, and rivet on dial feet. Remount on mandrel and face-off. Laser transfer design onto blank.
- *Engraving* - using X and Z axis engrave markers and numbers, adjusting depth of cut using hex screws on the block. Finish with hand engraver. Stone finish.
- *Waxing* - heat chapter ring, apply sealing wax. Scrape off excess with brass wiper. Clean with Acetone.
- *Silvering* - re-stone, apply paste, clean and lacquer.



Laser transfer of the design using nail polish remover



Engraving on the lathe



Cutting tool and rubber

# Spandrels

Task: Duplicate a set of eighteenth century spandrels.



Completed Spandrels and Screws

Preparing the Mould



Casting

Painting prior to gilding



## Work:

- *Mould* - attach example spandrels to perspex with thin layer of plasticine. Build wall around this with lego and plasticine. Mix and pour silicone rubber.
- *Casting* - in Pewter, using flexible blade to scrape off residue.
- *Trimming/Finishing* - pierce out and file to thickness. Drill and tap to M3.5. Finish using sharp blade.
- *Gilding* - three thin coats of Dulux oil paint. 1 coat of Size: (1/2 hour Japanese size.) Gild with circa 1cm squares of leaf.
- *Screws* - turn from square section brass. Tap to M3.5. Add slot and file-finish.

# Weights

Task: Work out how to make thin-skinned weights of correct size. Manufacture them.



Complete weight and counter-weight



Skins wired and tinned



Pouring the lead

## Work:

- *Design* - determine minimum weight that drives clock using shot and plastic bottle. Add 20% plus counter-weight weight. Calculate dimensions of cylinder that will hold that weight of lead.
- *Skin* - cut thin sheet CZ108 brass to correctly sized rectangle. True up butt joint with file. Tin, coat with flux.
- *Base* - cut circle of thin sheet, hammer out to dome. Tin, coat with flux.
- *Hanger* - turn & tap top of wood-screw to M3, flatten bottom, so it cannot twist.
- *Filling/assembly* - wire together. Sit in sand and fill with lead. Whilst lead is still molten, insert hanger dangling from temporary lid to keep it central.
- *Lid* - dome slightly thicker piece of CZ108. Insert on hanger and file to size.
- *Eye* - turn to size. Drill and tap to M3. File eye to shape.
- *Finishing* - planish bottom joint, finish with pumice powder, lacquer.
- *Hooks* - make forming jig and handle. Cut and form wire, file to shape.



Prototype showing shrinkage patterns as found in 18th century examples



Hook jig and evolution of hook shape

# Pendulum

Task: Produce aesthetically pleasing, functional 15 inch pendulum.



Completed Pendulum



Pendulum Components

## Work:

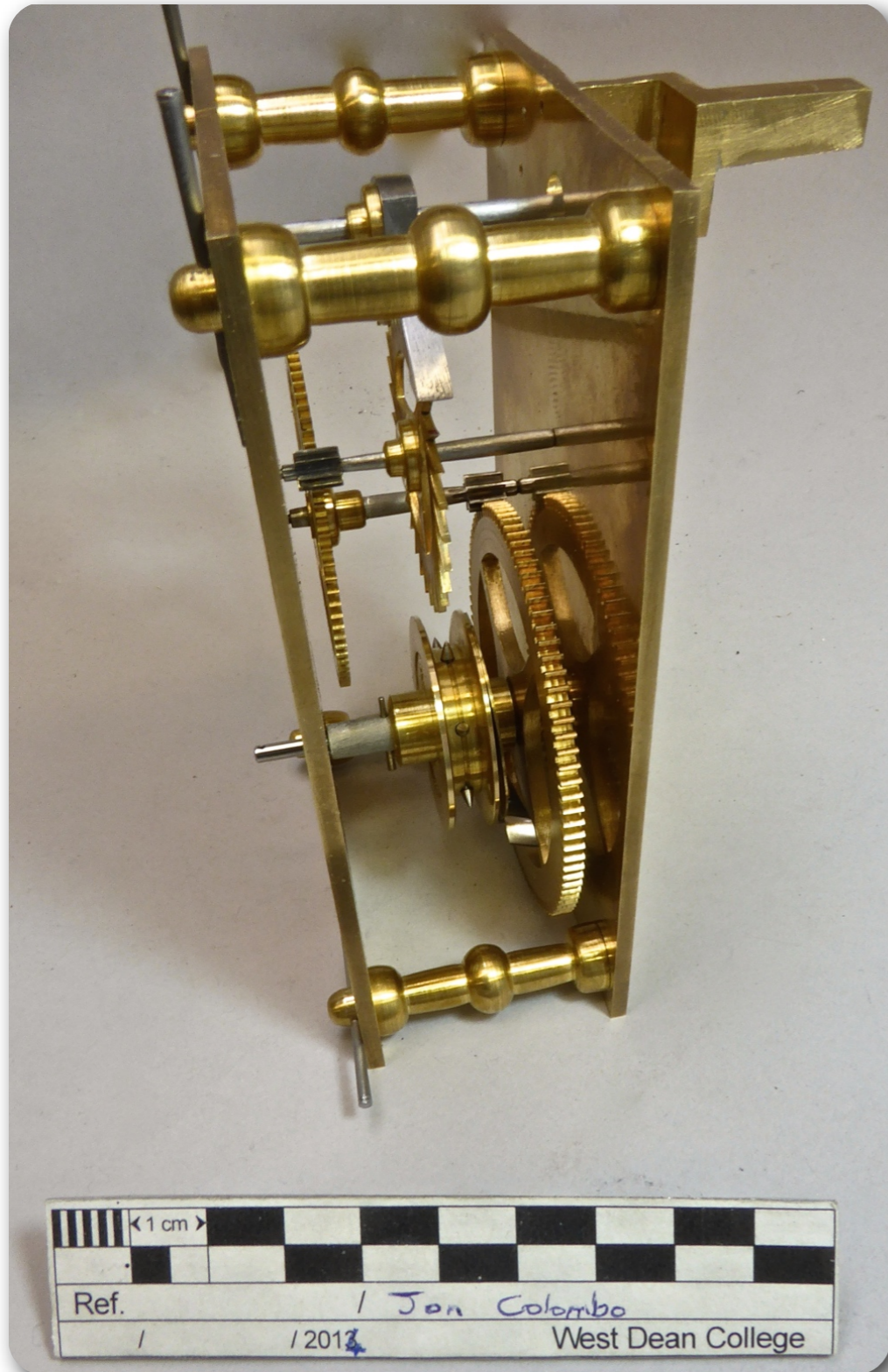
- *Design* - in conjunction with crutch.
- *Suspension* - formed from spring steel and CCI08 brass.
- *Top-block* - turned, filed drilled and tapped.
- *Rod* - steel, draw-filed and tapped M3 at either end.
- *Slide* - brass, filed to taper, tapped M3 at either end.
- *Rating rod* - steel, tapped M3.
- *Bob* - 2 shells beaten from CZ108 brass, filed to shape, silver soldered together. Holes filed top bottom and centre. Slide and rating thread protected with graphite powder. Bob filled with lead. Pouring cone cut off, lead adjusted. Bob finished and lacquered.
- *Adjusting nut* - turned, convex knurled tapped M3.



Bob prepared for filling

# Motion Work

Task: Produce quality wheels, pinions and arbors appropriate for and eighteenth century clock using techniques available to a contemporary clockmaker.



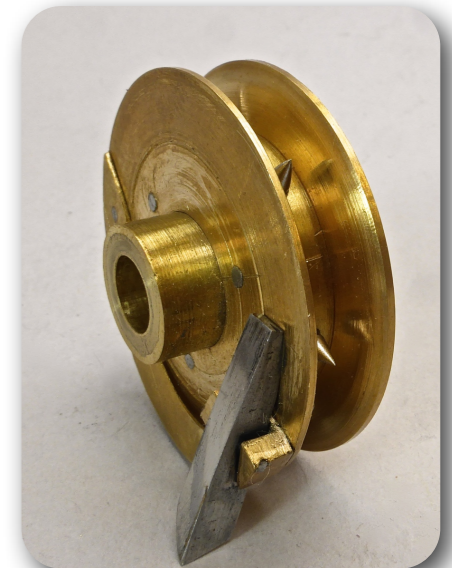
Assembled Motion Work



Motion Work, front plate removed



Under-dial



Winding Gear

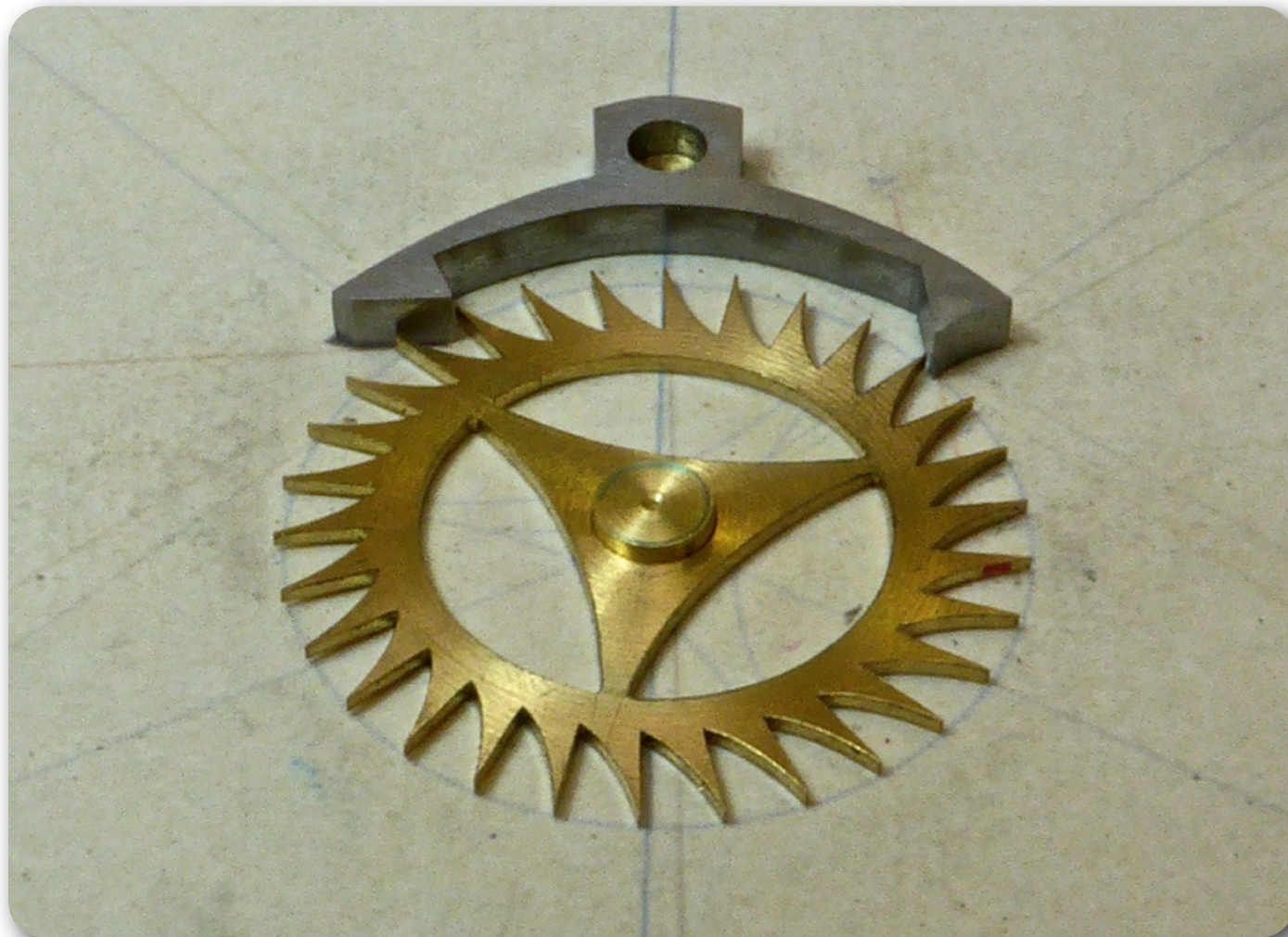
## Work:

- Design - draw and dimension.
- Wheels - cut teeth on Schaublin with dividing head and Thornton's cutter.
- Arbors - turn in steel, draw file. Harden/temper pivots once pinions are cut.
- Pinions - cut leaves on Myford with dividing plate on headstock.
- Winding gear - manufacture in components (click, click spring, spikes, core, cheeks, pin) work harden spring, finish, press in spikes then rivet together.
- Under-dial - (Wheels as above) work harden/dome spring, cut to shape. Pipes cut to broach taper and accurately aligned.



# Escapement Wheel/Pallets

Task: Produce Escapement Wheel and steel Pallets of an appropriate quality and design.



Experimental wheels



Brass and Steel Pallets



Experimental wheels

## Work:

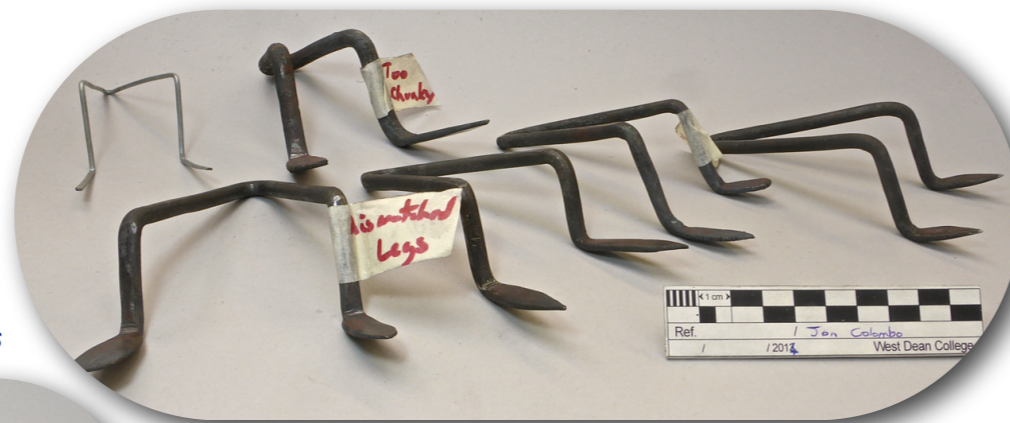
- Design - both Pallets and Wheel, draw and dimension.
- Jig - as for escapement model.
- Wheel - as for escapement model, except use Schaublin dividing head to cut teeth.
- Brass Pallets - as for escapement model.
- Steel Pallets:
  - Mark, drill, then cut in 4mm Gauge-Plate, cutting as close to lines as possible.
  - Follow same process as for Brass Pallets, stopping just before each side drops.
  - Harden, then Temper to very pale straw.
  - Refinish, polish pallets and finalise the drops.

# Hoop and Spurs

Task: Forge mid eighteenth century style hoop and spurs. Finish appropriately.



Hoop, Spurs and wall-hook



Prototype Hoops



Prototype Spurs

## Work:

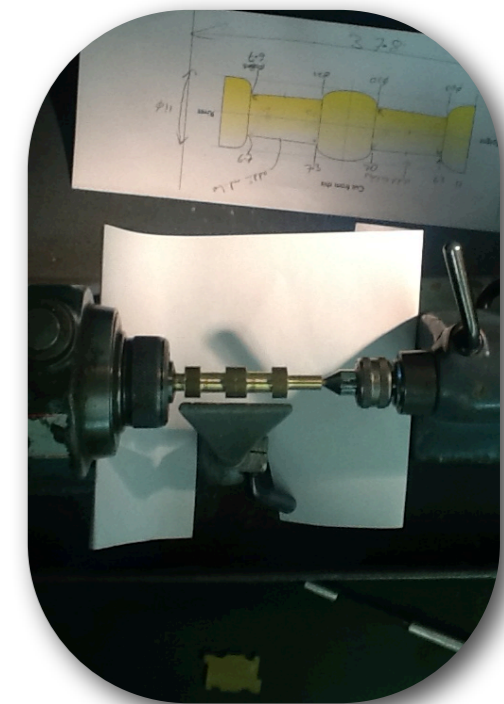
- Design - Research, dimension, draw.
- Hoop - (in forge) understand techniques required and apply:
  - Cut to length.
  - Mark, heat, fold in middle, use water to make tight bend.
  - Mark, heat, half-form ankles.
  - Mark, heat, fold 'knees' in one operation.
  - Heat, open up first fold to form nail angle.
- Spurs
  - In forge: Mark length on anvil, heat then shape two ends of a bar.
  - In workshop:
    - Cut to slightly slightly over-length, face off and drill centre.
    - Turn Aluminium button to hold pointed end in collet.
    - Turn shoulder for thread between button and centre, then tap.

# Pillars

Task: Produce Pillars that are aesthetically correct, consistent and to exact height given.



Completed pillars

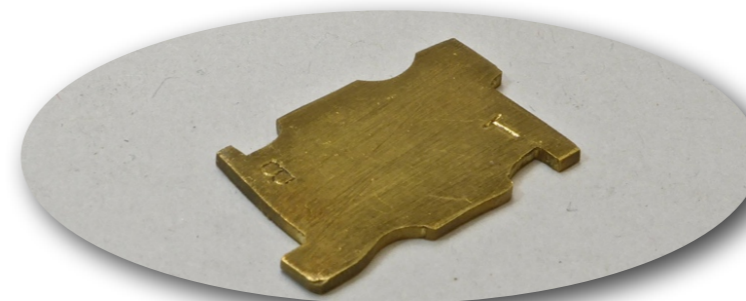


Turning Pillars

## Work:

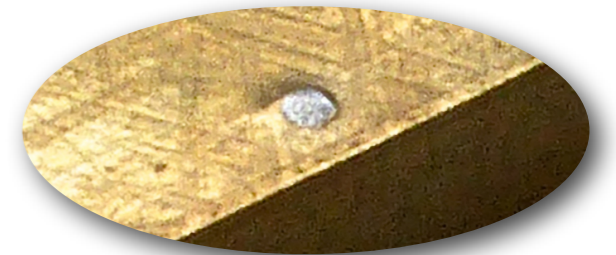
- Research
  - Understand eighteenth century pillar design.
  - Explore shapes that are aesthetically pleasing through drawing.
  - Decide on design.
- Execution
  - Rough-out pillars to dimensions using lathe tools.
  - Produce prototype pillar using graver.
  - Make shaping Jig based on this.
  - Replicate pillars using graver.

Shaping jig

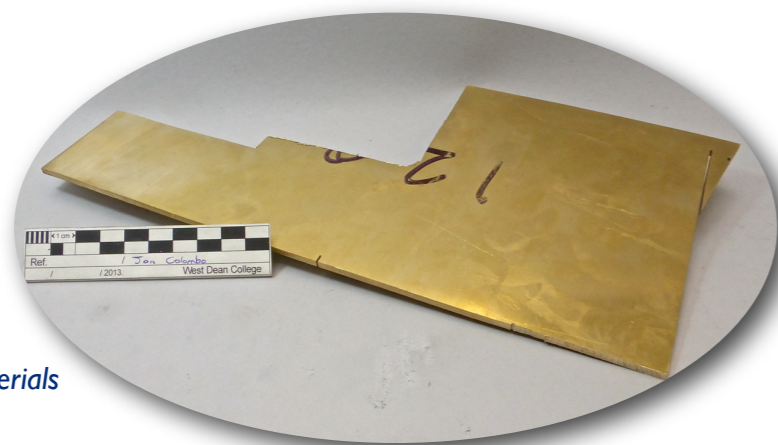


# Plates

Task: Produce Plates appropriate to mid-eighteenth century clock.



Detail: Pinning



Materials

## Work:

Take brass sheets roughly cut to size:

- *Mark out*
- *Surface:* Choose appropriate finish and execute it - Scraped finish
  - Scrape with file scraper.
  - Fine finish with Pumice Powder using cork block.
- *Pin together:* Drill, broach hole. Use temporary pin to hold whilst drilling second hole. File pins to size. Insert, then rivet.
- *File to size:* ensure edges are square in all 3 axes.

# Escapement Model (Formal Exercise)

Task: Make a working Anchor Escapement model to fully understand geometry and process.



Completed Model

## Work:

- Design - both Pallets and Wheel, draw and dimension.
- Mandrel - turn, thread, (mandrel and nut) solder brass sleeve.
- Jig
  - Mark out, drill for 2 bosses.
  - Turn bosses then press into jig.
- Wheel
  - Make fly-cutter, file, harden, temper.
  - Cut roughly to size, work-harden, face off in 6 jaw chuck.
  - Mount on mandrel, cut to correct diameter.
  - Cut teeth using 'wheel of death'.
  - Make boxwood chuck, use to re-centre.
  - Cross-out - mark on Jig, cut with piercing saw and files.
- Pallets
  - Mark out.
  - Drill, broach pivot, then cut shape with piercing saw.
  - File and burnish pallet surfaces,
  - Fit to Jig, sequentially file each side until drops work.
  - File to Finish.



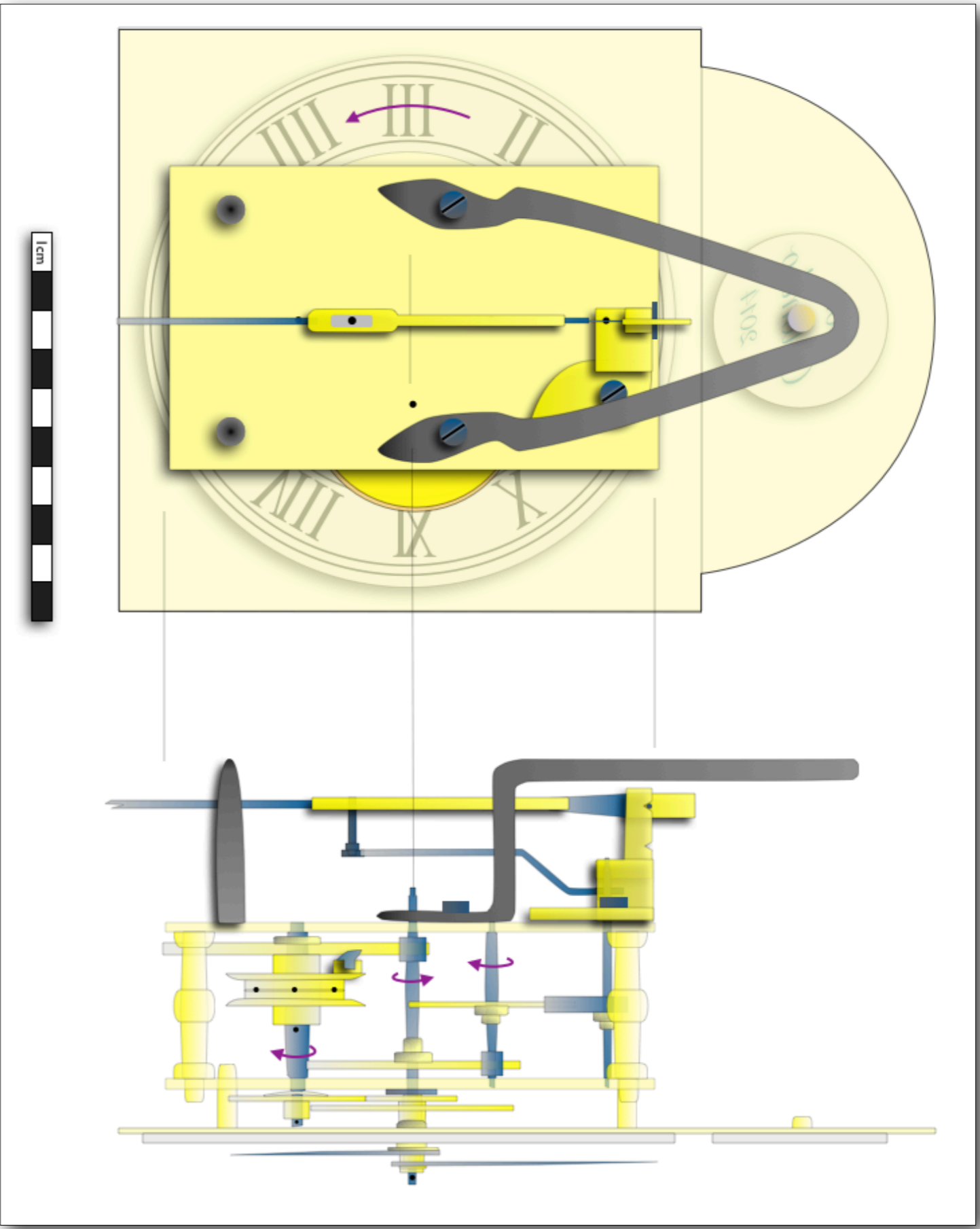
Mandrel



Fly Cutters

Pallet Evolution





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JON COLOMBO, JUNE 2014

[clx@gocolombo.com](mailto:clx@gocolombo.com)