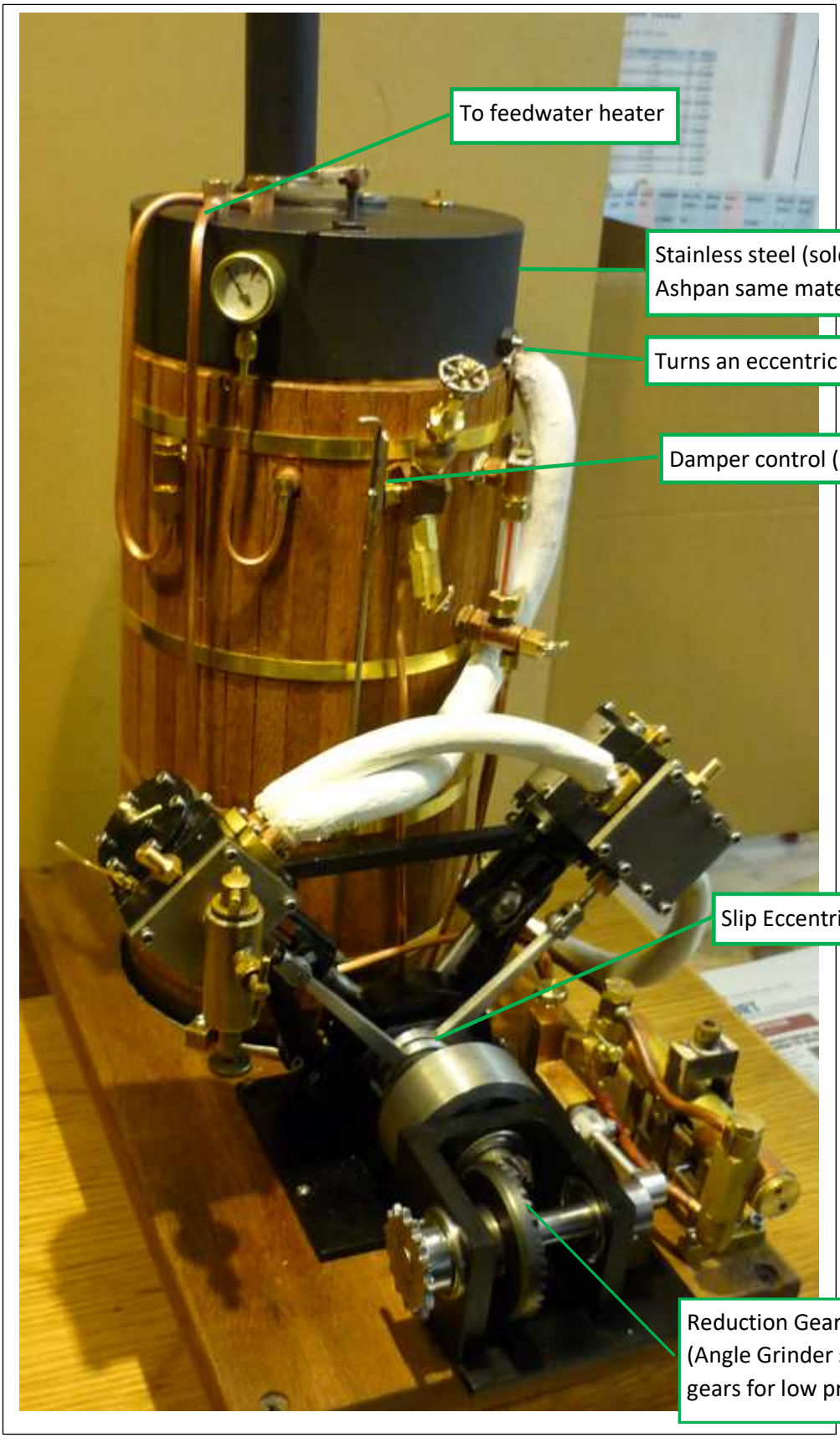
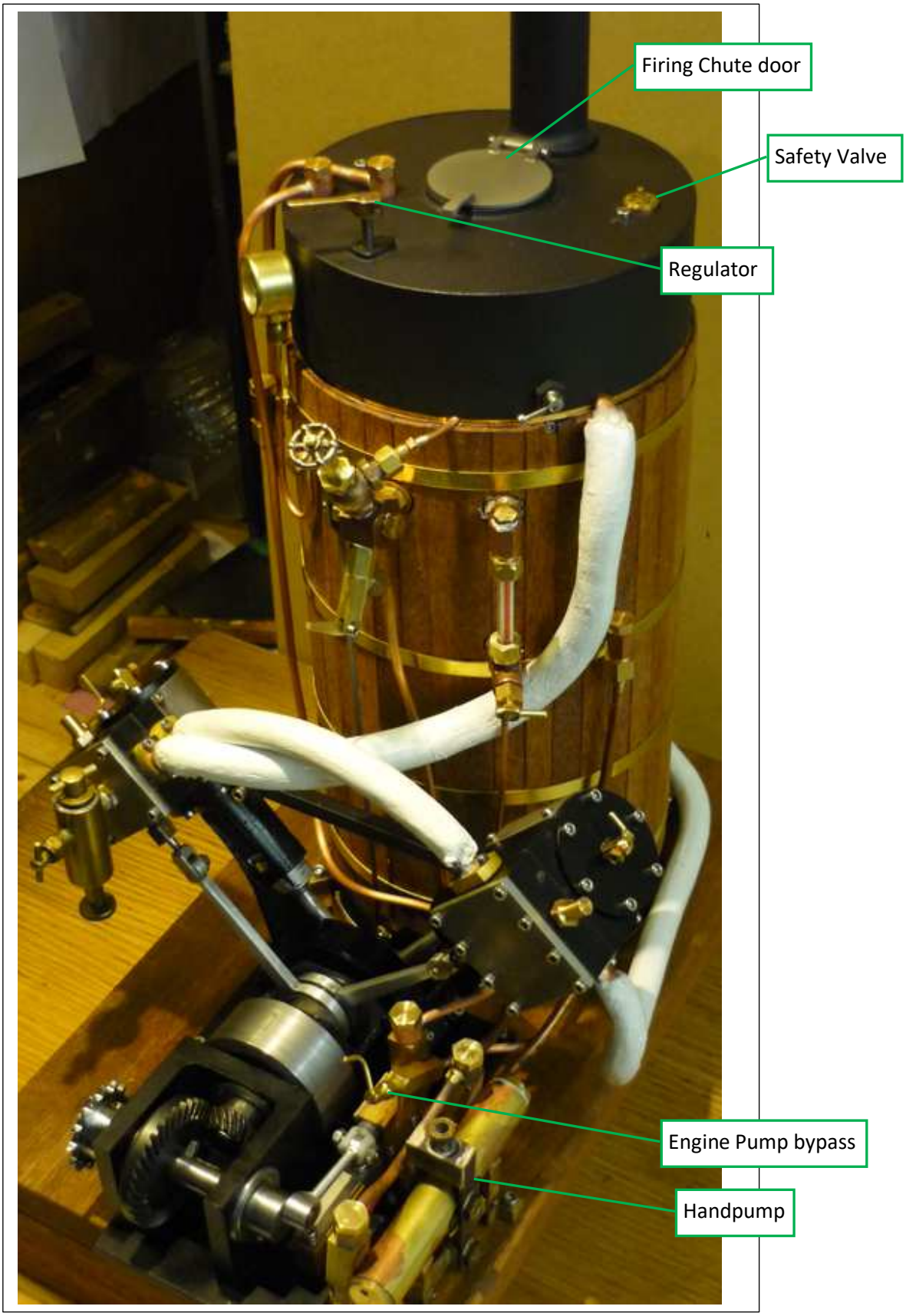
Steam Power Plant

Current state




Firing Chute door
Safety Valve
Regulator
Engine Pump bypass
Handpump

Underlying Ideas

A "quickie" project to work on during the Covid disruption

May be able to power a 5" gauge driving trolley at up to 5 mph. Adhesive weight provided by passenger!

Design Decisions (engine)

A compound

- gives expansive use of steam without needing elaborate valve gear

A vee twin

- can use single web crankshaft to avoid split bearings (can then use "off the shelf" ballraces and bushes)
- can have 100% primary balance (i.e. run at high rpm without significant vibration enabling small engine to develop reasonable power) – *both pistons need to be the same weight, so HP piston is cast iron and LP piston is aluminium alloy*
- self-starting

Disadvantage – bulky

Aluminium Alloy where possible

- Good strength/weight ratio
- Inexpensive and easy to machine

Disadvantage – can corrode badly in contact with other metals (esp. copper and brass!)

Details

- ¾" stroke, HP cylinder ¾" bore, LP cylinder 1 ¼" bore
- Stuart 90 castings used for columns but remainder stock materials
- Dimensions loosely based on Stuart no. 10 but
    - used bigger valves, passages and longer valve travel to make free-revving (probably unnecessary)
    - larger diameter crankshaft, big and little ends

Design Decisions (boiler)

Base on standard published design (*underlying issue might be club insurance concerns over a non-standard design*)

Vertical firetube (small "footprint" and relatively easy to build – *compared to a locomotive boiler*!)

Details

Based on Clayton Undertype boiler see https://www.model-engineer.co.uk/sites/7/documents/clayton.pdf pages 24-27

Modifications

- 1" taller (3/4" to increase firebox height and ¼" for extra water capacity)
- Firing Chute 1 ½" OD rather than 1 3/8" OD
- Revised tube layout to include two superheater flues (Clayton only had a smokebox superheater)
- Clinkering hole omitted (would complicate the construction and seemed of little practical value)
- Large feedwater heater in smokebox *see comments in **#1** below*

Lagging

Layers are PTFE baking sheet, Aluminium exhaust wrap, 2mm ceramic fibre & 2mm mahogany veneer

#1 The first steaming was very encouraging (easy to fire and safety valve blowing while engine running at very high RPM) Will need to get a rev counter for a better assessment.
The exhaust was very “dry” suggesting more than adequate superheat.

K. N.Harris states that vertical firetubes are far less efficient than horizontal ones.
(Model Boilers and Boilermaking published 1967).
I then assumed that a lot of heat could end up in the smokebox; hence the feedwater heater.
However K.N. Harris may have based this on fullsize boilers. (*fullsize locos have turbulent flow in tubes which helps heat transfer. In models it is apparently laminar*)

It’s early days, but the feedwater heater didn’t seem to heat the water very much in this first steaming. (and the smokebox didn’t get very hot).

I’ve recently read that, especially in a model boiler, most of the heat is transferred in the firebox and the tubes do comparatively little.

See below for photos of boiler construction.

Top tubeplate ready to silver solder (used Silverflo 55 and Easyflo flux throughout)

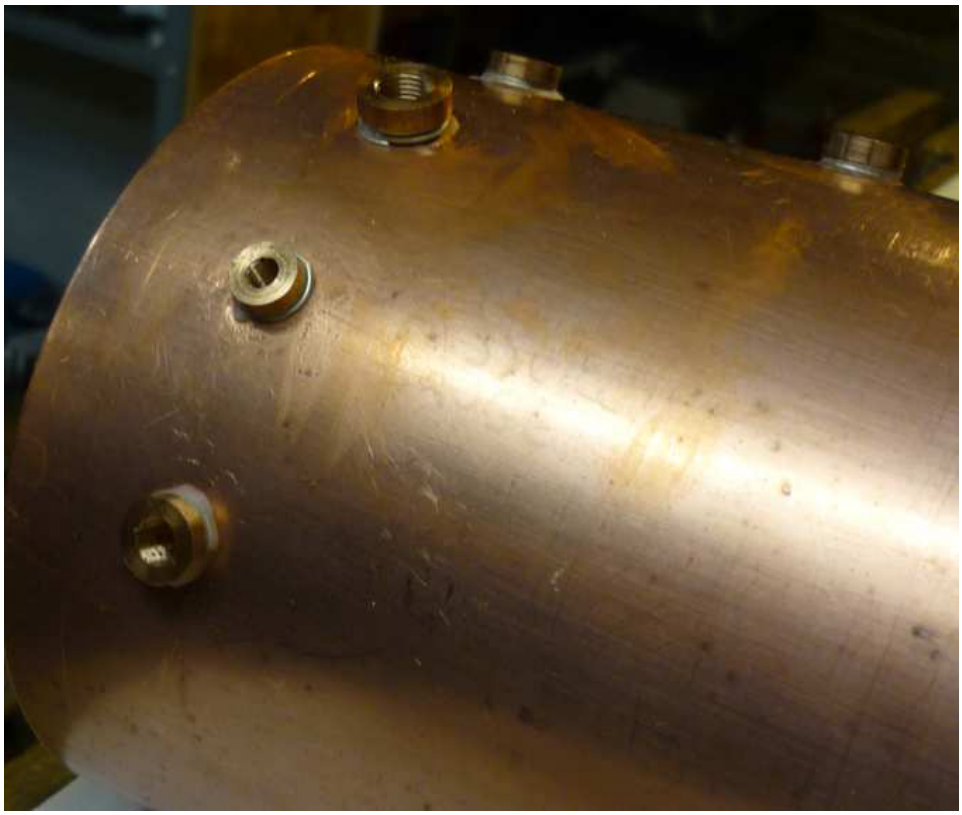
After heating

Dodgy bit (was re-silver soldered)

Bottom tubeplate soldered and ready to solder into inner firebox

From below after soldering

Bushes ready to solder into barrel



Inside barrel after soldering and cleanup

Inner and outer soldered together at bottom – dodgy bits marked for re-soldering

Inner and outer soldered together at top – dodgy bits marked for re-soldering

Top complete

Bottom complete