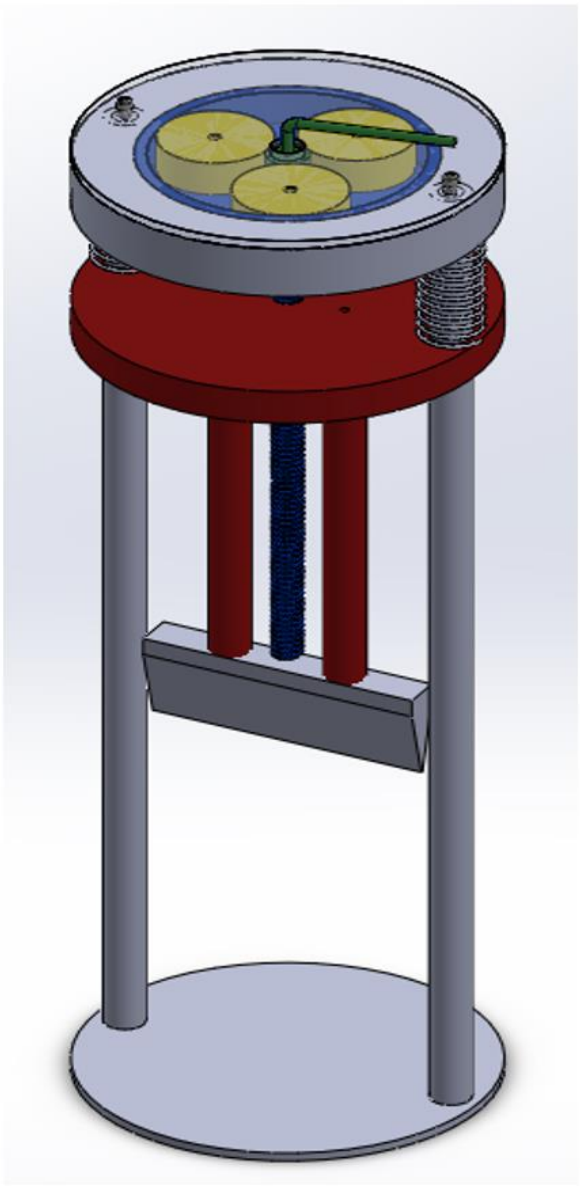
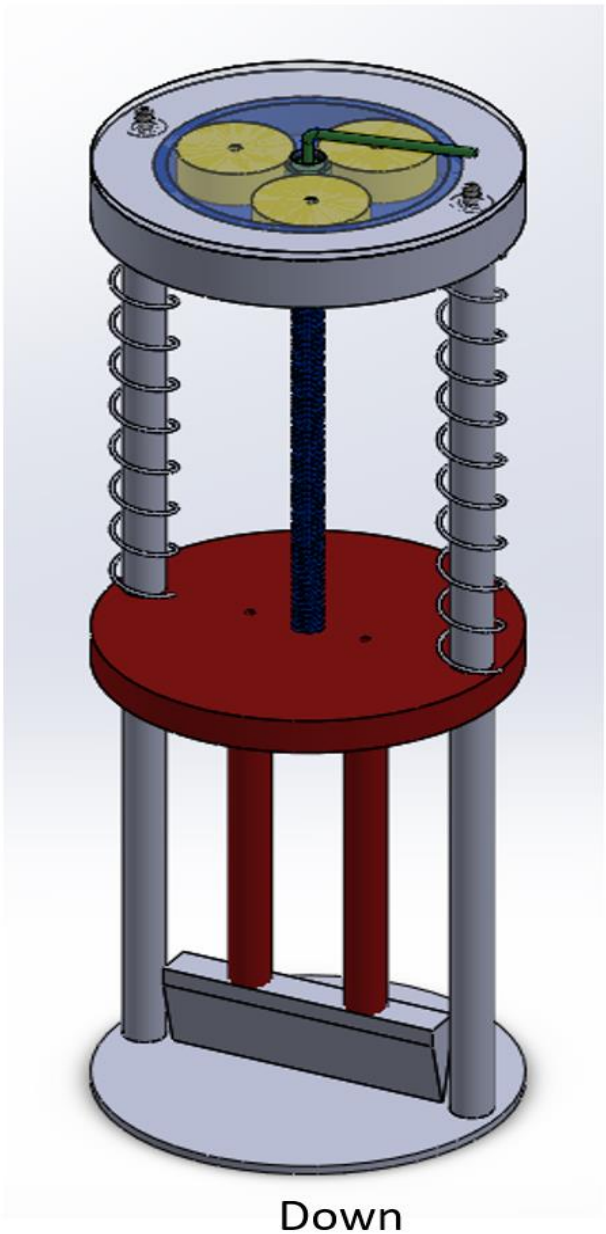
Log Splitter



Up



Down

This project was centered around following the given load to split the log and essentially to “follow” the load through the machine in order to appropriately design springs, gears, screws, and fasteners in order to be able to move up and down in order to split a log. A person applies a force up to five pounds to a handle which acts as the input to the sun gear, turning the planet gear, then outer ring which acts as the input torque to the power screw, moving the splitter up and down. The mechanical advantage from the gears amplifies the input force allowing the user to split with upwards of 400 lbs with only 5 lbs of input to the handle.

Answer Sheet:

Input Values **Output Values**

Springs:

1. Diameter of wire .105 in
2. Spring Index 4

A FBD exposes the working forces on the spring, solving for the forces in the up and down positions allows you to solve for the # of active coils and allows you to then get values for spring constant k. It is important to note that the two springs are equal to each other and therefore work together to either work with the power screw or against it.

11. Outside Diameter .525 in
12. Desired Spring Constant 5.43 lb/in
13. Number of active coils 434
14. Actual Spring Constant 5.43 lb/in
15. Free Length 64.2 in
16. Actual Initial force 13 lb
17. Actual Working Force 87 lb
18. Shut force 100 lb
19. Shear to shut the spring 104 kpsi
20. Factor of safety to shut the spring 1.1

Power Screw

3. Power Screw Major Diameter 1 in

This screw can just be looked at as "upside down" using the splitting load as the load to be "raised". The screw works closely with the gears as the outer ring is the input torque for the screw. Moving to the "up" position acts against the springs and does not include any forces from splitting.

21. Torque needed **on the power screw** to begin splitting a log 76.2 in-lb
22. Torque on the power screw generated by the spring to start raising the splitter from the bottom position -48.1 in-lb
23. Is the thread self-locking? yes
24. Efficiency of the Power Screw system 31.7 %

Gears:

4. Number of teeth on the Input Sun Gear 33
5. Number of teeth on the Planet Gears 21
6. Diametral pitch of the gearset 24
7. Length of Handle 5 in

The gears work to amplify the input force from the person, using mechanical advantage to create force strong enough to split the log. By input only up to 5 lbs can still generate up to 400 lbs of force and above by merely messing around with the number of gear teeth

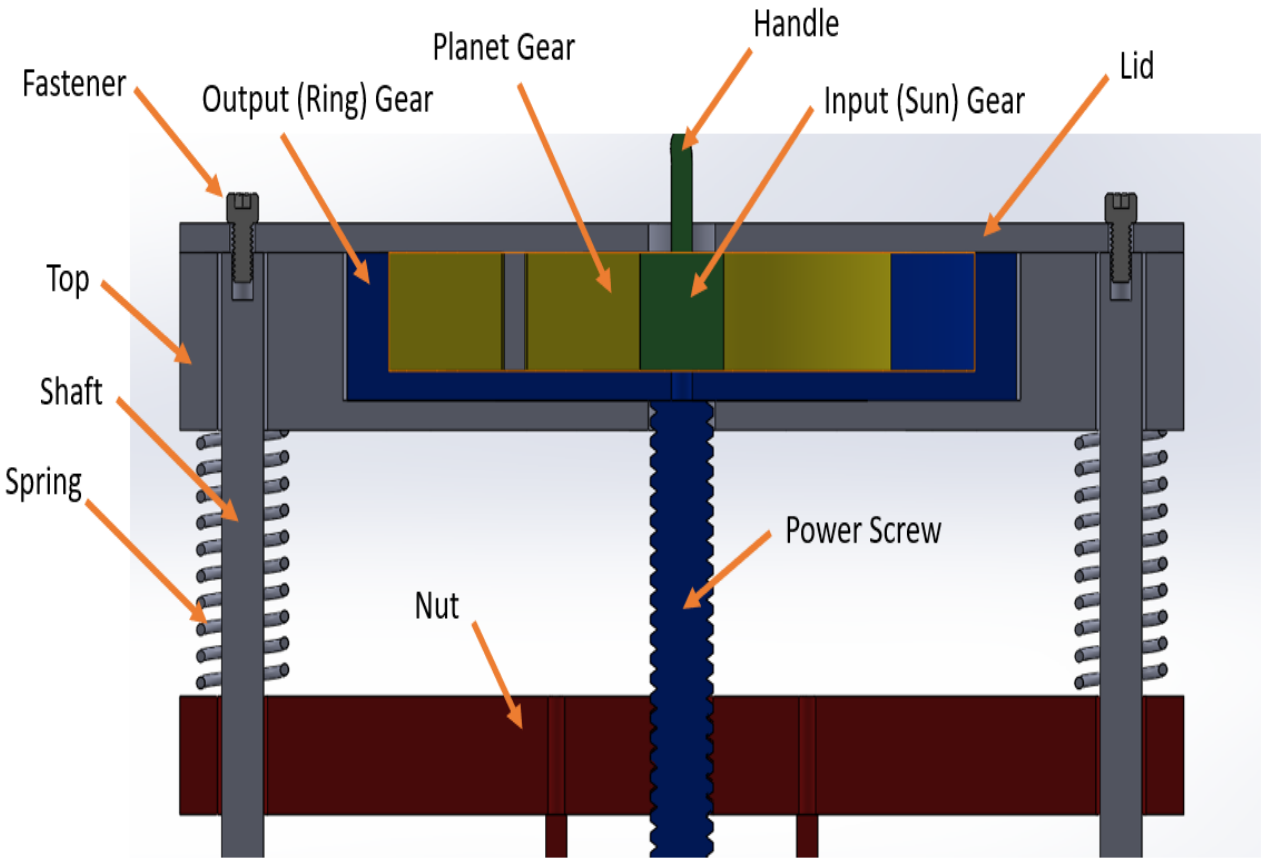
25. Gear ratio 1.64
26. Number of teeth on Output Ring Gear 75
27. Torque needed on the handle to split a log 46.5 in-lb
28. Force needed on the handle to split a log 9.31 lb
29. Diameter of the Ring Gear 3.21 in

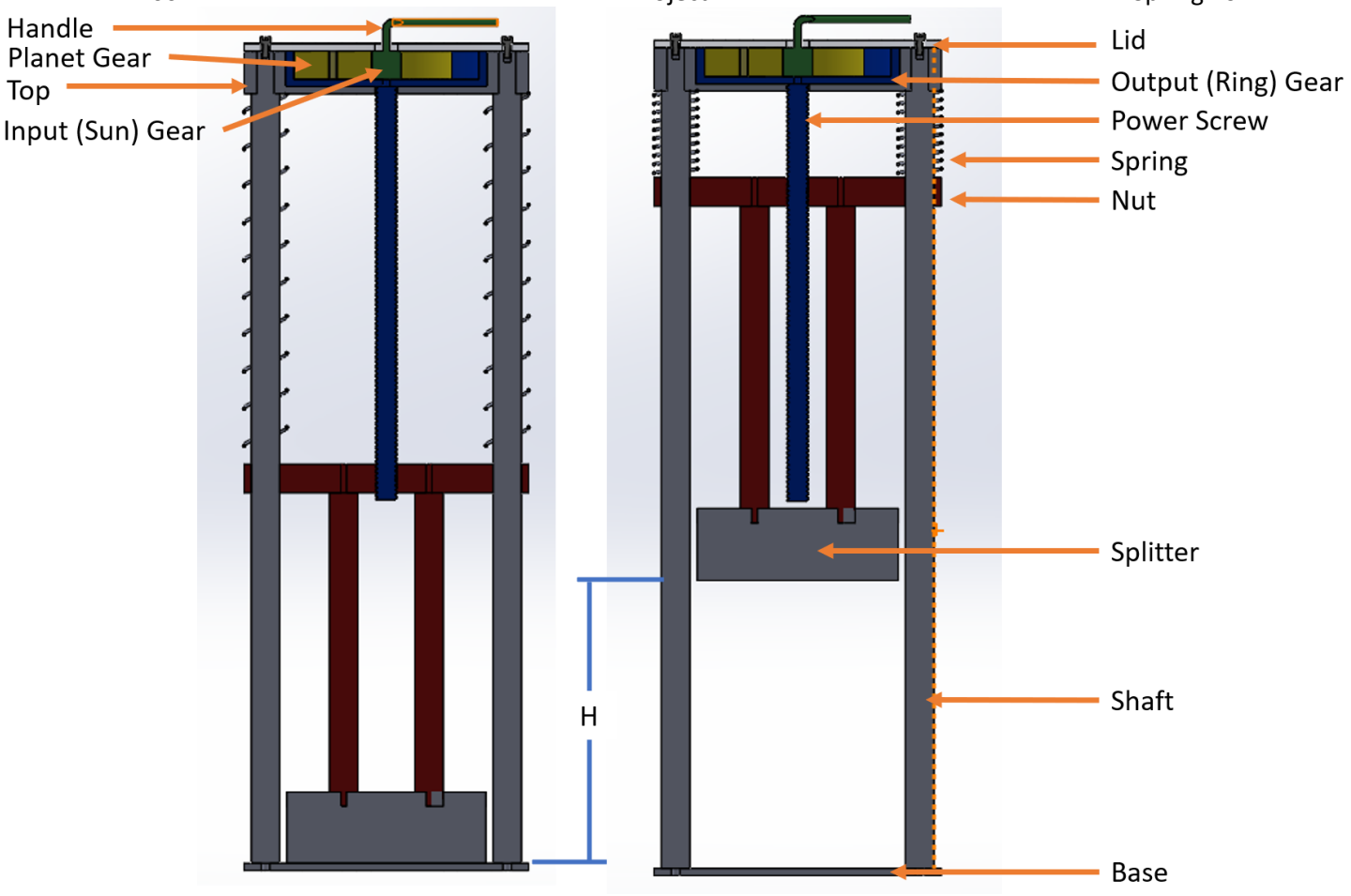
Fasteners:

8. Major Diameter .216 in
9. Grade 1
10. Preload 70 %

30. Joint Stiffness Factor .519
31. Tensile Area .024 in^2
32. Factor of Safety of Yield 1.1
33. Factor of Safety of Separation 2.9

The fasteners hold the frame together and help bear the splitting load.




Handle
Planet Gear
Top
Input (Sun) Gear
H
Lid
Output (Ring) Gear
Power Screw
Spring
Nut
Splitter
Shaft
Base