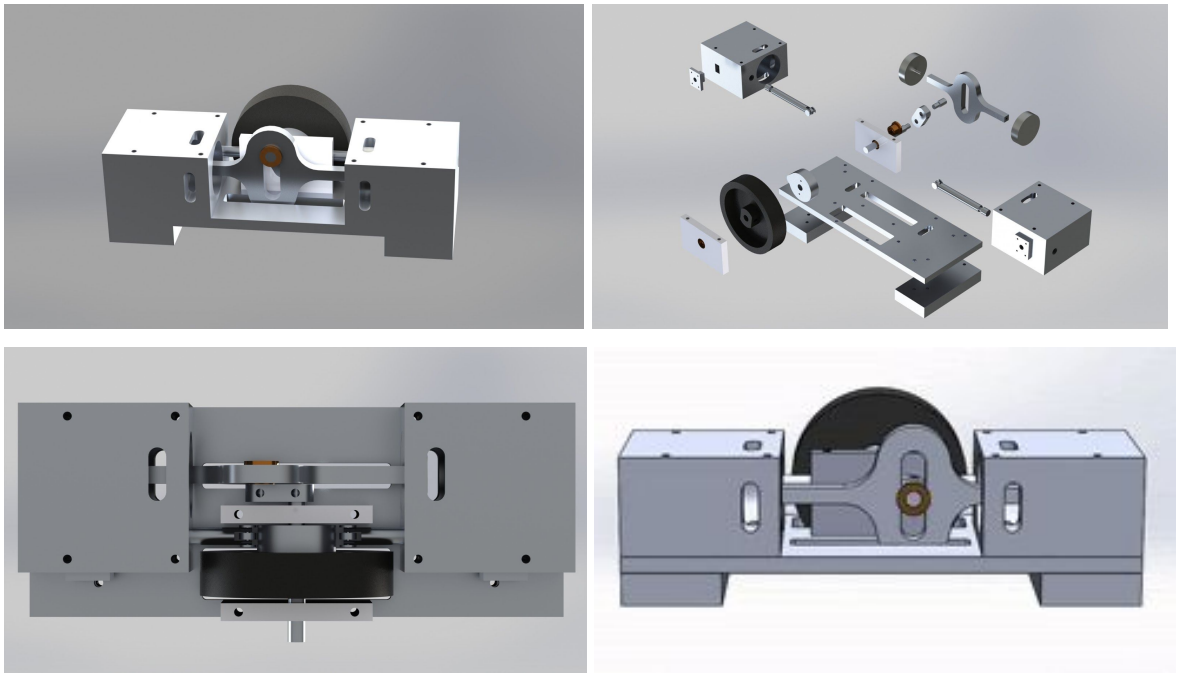
Greensteam Design Report: Scotch Boxer Engine

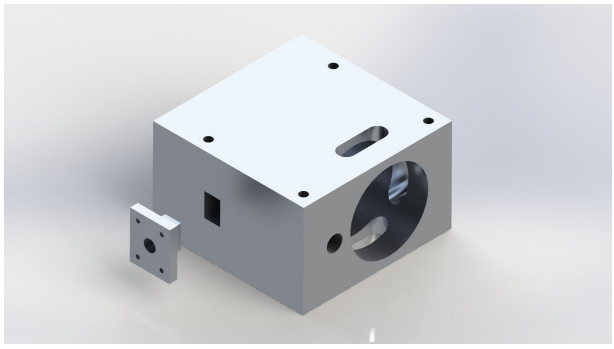
Eric Lopez, Fall 2020

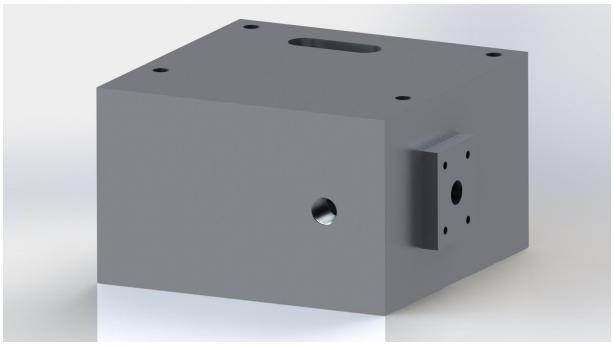


This is a boxer engine with a Scotch Yoke mechanism. This engine utilizes the Scotch Yoke which translates linear motion from the cylinder into rotational motion while also reducing the complexity relative to that of a traditional crankshaft. Steam enters through the inlet valve on the sides of the cylinder blocks which cause the piston to expand. As the piston expands the rotation in the crankshaft also rotates the cam which causes the inlet valve to open and close allowing each piston to expand in an alternating fashion. When the piston is fully expanded steam is allowed to exit through the exhaust ports. The goal this quarter was to create construction drawings for the model and also to improve the design of the engine by reducing complexity of the design and making it easier to manufacture. There were issues with a return mechanism for the inlet rod as it had no way of staying in full contact with the cam. This was resolved by adding a spring return system for the inlet rod and expanding the size of the cylinder blocks by ½ an inch to accommodate space for the spring system. Some modifications to the design included removing the inner cylinder, replacing bearings with sintered bronze bushings, expanding the cylinder block and simplifying the design of the support plates.

Part Breakdown

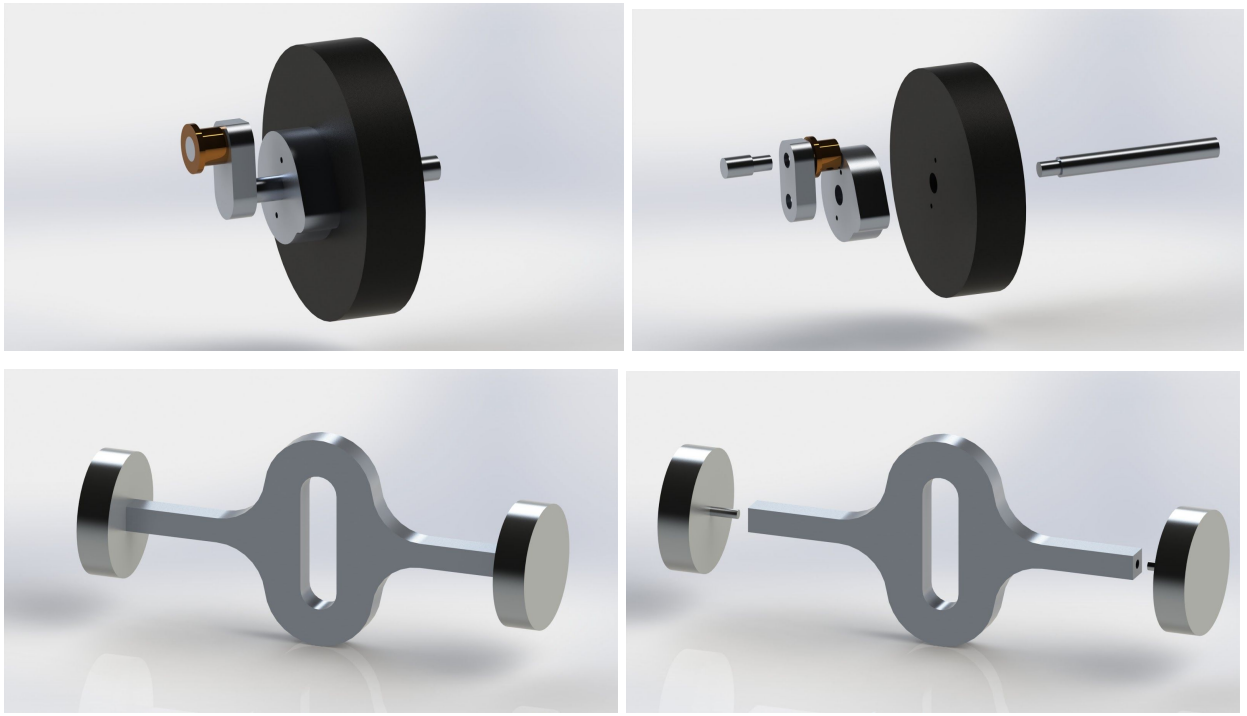
Engine Block





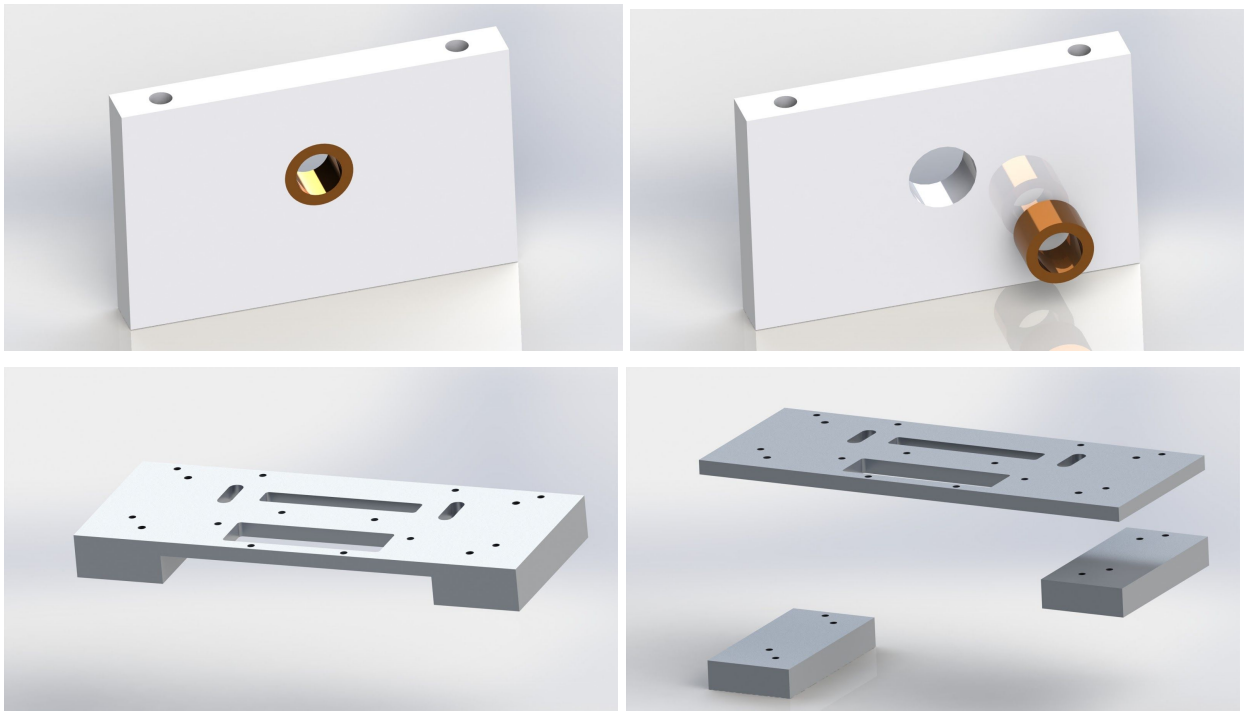
The engine block is composed of an entrance for the piston, three exhaust ports, and a steam inlet port on one side and a threaded hole in the other that will be accompanied with a grub screw and spring. The engine block was elongated by half an inch to accommodate a spring system that could keep the inlet valve in constant contact with the cam. The spring return system will consist of a grub screw and a threaded hole on the side of the engine block opposite to that of the piston entrance. The inner cylinder was removed as well, this was done in an effort to reduce the complexity of the design and make it easier to manufacture. The end of the inlet valve was enlarged from ⅛ to ⅜ of an inch so more surface area would be in contact with the cam in an effort to reduce wear on the part over time.

Scotch Yoke Crankshaft



The crankshaft is composed of a flywheel, cam, connectors and a main shaft. The geometry of the cam was created with the intention of keeping the steam valve open for approximately 15% of the stroke. It is connected to the Scotch Yoke which is responsible for converting the linear motion of the piston into rotational motion without the need of a very precisely manufactured camshaft. The yoke mechanism was selected for this feature and should be relatively easy to create with a CNC router. A clearance of .05 inches was added to the design of the piston head on the yoke and the bearing on the crankshaft was replaced with a sintered bronze bushing.

Base and Support plate



The base plate is elevated by two legs so that the center of rotation can lie closer to the base plate. The two support plates provide stability for the crankshaft, yoke, and flywheel and also bolt the assembly down to the base plate. The base plate was elongated by an inch to accommodate for the changes made to the cylinder block previously mentioned. The support plate was modified so that it is now a simple rectangle with holes to mount onto the base plate and a hole to accommodate for sintered bronze bushings. This was done in an effort to again reduce the complexity and make it easier to manufacture.