CHAPTER

10 Wooden Grasshopper Engine

This is a project for the wood and metal worker — a grasshopper type which turned out quite well.

The cylinder and valving are a near duplicate of the Wood Beam Engine. The parts made of wood are a bit different. There is no metal hub in the flywheel and metal pieces were inserted to increase the weight as noted by Ralph Weidman in his model. The crank is wood with a metal pellet added as a counterweight. The frame uses a simple construction, no mortise and tenons. The builder can use his own ideas. Wood cannot be worked as precise as metal, so warpage, a tiny slip when gluing, etc., may require a bit of shimming and filing at assembly to get satisfactory alignments. It is a fun engine to build, not difficult, and it is a good conversation piece to show off at the club meetings.

Select hard maple or any dense hardwood for the FRAME. The wood in the model shown is a Central American wood quite like maple. When making the wood pieces, try for all the accuracy you can get. Make all the notches and inserts close so, at final gluing, it will be square and well aligned. Drill the holes in the two outside timbers and clamp to the next piece so you can use it as a jig for spotting the tiebolt holes. Do this on all the related pieces. When all the holes are made in these frame pieces, enlarge, if necessary, all the holes in the inbetween pieces .008" to .015" so the long tiebolts will enter easily. Make all the holes in the Column, Pivot and Bearing Support before gluing. It will be difficult, if not impossible, after assembly. The tiebolts help the clamps when gluing.

If the BUSHINGS in the BEAMS are not a snug fit, set them with epoxy glue.

The FLYWHEEL is made of 1/4" layers built up in hex form and the inside diameters very carefully jigsawed so all three rings match.

Make the SPOKE-HUB a close fit in the center ring. File the 1-7/8" radius to match the inside diameter of the outer rings. The Spoke is centered in the middle ring and a prick punch mark for the Shaft centered off the 3-3/4" ID of the Ring. With care, the punch mark should center in the middle of the Spoke, as well. Drill four holes for #2-56 bolts in the Spoke before gluing. The 1/4" Shaft bore is done later. The three layers with the Spoke in place should be assembled with small clamps check for fit and alignment. tongues on the ends of the Spoke hold the rings in place while the inside diameters of the rings are matched.
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Drill two small holes in the waste area for small brads that will prevent sliding when gluing and clamping. DON'T FORGET THE STEEL WEIGHTS. When the glue has set, jigsaw the outside diameter a bit oversize. Chuck the Wheel, gripping the rim I.D. in your metal-working lathe 4-jaw and center the prick punch mark with a center test indicator. If all is well, the rim I.D. will run quite true and be satisfactory. Carefully turn the O.D. with a keen tool bit. Drill the 1/4" shaft hole. Take back to the jigsaw and add the slot at the center. When all the wood parts are glued and sanded, they can be given a fine spray coat of varnish.

At this point you are finished with the wood work section of this engine and can now get into the metal work that gets the engine running.
VALVE ARM PIVOT
Wood

BASE
All parts = Wood
All bolts = Brass 3/8 dia., thread #3-48
FLYWHEEL
Hard Maple or equivalent
1 Required

HUB

18 pieces required for 3 rings flat and smooth uniform thickness

1/4 after assembly

Saw cut after boring 1/4

Break joints front ring center ring rear ring

Pierce center ring spot four holes for 1/4x1/4x1/4 steel weights

Drill 3/32 before assembly for #2-56 bolts

The sub-assemblies of the Wooden Grasshopper are pictured above, while the wooden parts of this engine are shown below.
At this point, we begin the metal working section of this project. Basically, this portion is straightforward machine practice with only a few pointers to be offered to, hopefully, make your work easier.

Spot the setscrew in the **ECCENTRIC** on the centerline through the shaft and offset. The Allen wrench in the setscrew helps in timing the engine. At assembly, with the **CRANK** at midstroke, the setscrew...
Side view of the Wooden Grasshopper Engine

The metal parts for the Wooden Grasshopper Engine

Valve Linkage
Brass

Valve & Cylinder Assembly

- 4 tiebolts 3/8 dia., 2 3/8 long thread #3-48

1/4 O.D. brass tubing (3/8 i.d., straight and smooth)
- Mount flanged tubes on cylinder and solder
- 3/8 O.D. brass tube, .035 wall

Valve Housing Assembly
All Brass
should be on the vertical centerline. If the CRANK ARM does not grip the smooth shaft tight enough, a bit of epoxy glue can be used or a light, fine knurl added to the Shaft for a more positive drive.

The CYLINDER and PISTON are straight machine work and pretty well covered by the drawings. Use your favorite Packing.

The VALVE ASSEMBLY is mostly tubing. The flanges are soldered to the Cross Tubes and mounted on the Cylinder. The valve ends of the Cross Tubes are filed to fit around the Valve Tube. The Valve Tube is held against the Cross Tubes by soft wire while soldering. Drill through the Cross Tubes into the Valve Tube and remove the burrs inside. Make sure the Valve slides smoothly and not too sloppy in the Valve Tube. A three-cornered scraper made from a small file is handy for this job.

The 1/2" long STEAM INTAKE TUBE is made with the end fitted around the Valve Tube. Clamp together and solder. If there is a threat that the heat will soften the soldered joints already made, dip pipe cleaners in water and wind around the Valve Tube each side of the intake near the Cross Tubes. They will absorb the heat. Drill through and remove burrs. The important area to keep in fine condition is at the Cross Tubes where the Valves operate.

This engine will run on very low air pressure. The slot in the end of the Valve Stem will help you fine-tune the engine using a jewelers screw driver. Until the Valve is centered, the Piston will tend to go to one end and stay there. Adjust until you get a nice even sound at each end of a stroke.

Try to run as slow as possible. A large engine of this sort would hardly run 25 rpm.