Construction Notes for the Mini-2V CO2 compressed air engine.
9/9/2003

This is a set of photos and notes that should help better understand the parts and drawing used in this engine.


Square steel key stock was used for the cylinders.


The rough cylinder.


Fins were cut with a slitting saw blade held like a cutter. The bore was drilled slightly undersize. Counter bore was added for the valve disk. The Inside was honed with 400 grit lapping compound until a section of ¼ drill rid fit in, then that was lapped to perfect fit.

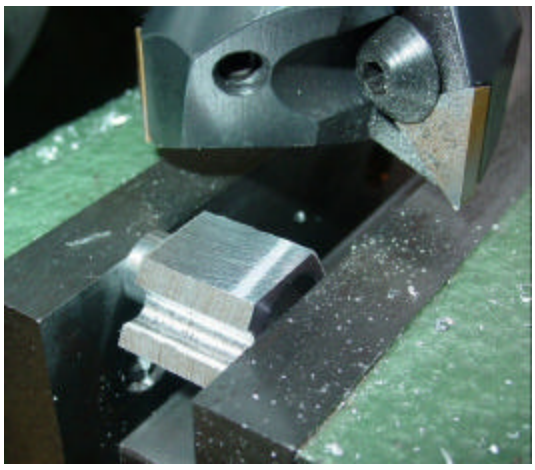

Keep inside flange long to hold in chuck while drilling head and exhaust holes. Turn to length later. The ID needs a champher for connecting rod clearance.

Drill the mounting holes. Later using a 1/16 diameter burr, angle and elongate the holes so the screws will enter.

Turn bearing boss.

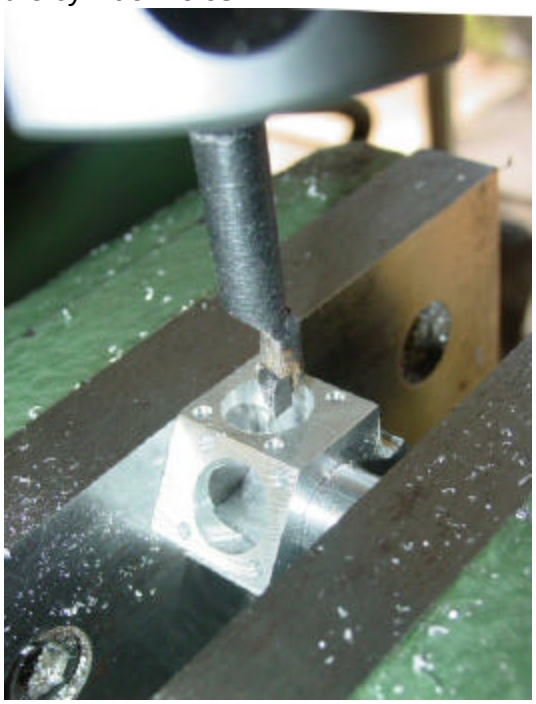
Rough bore the inside using 4 jaws.

Turn to correct diameter and depth holding bearing boss to improve concentricity. Use light cuts so it will not slip.



Drill 2 holes to start side flutes and mill to size.

Center drill. Use a large one the start the cylinder holes.



Bore cylinder holes.

Drill bolt holes in head.

Drill bolt holes in cylinder. If it is done in the same setup the holes will be

perfect. Be sure to align the pattern to the flats

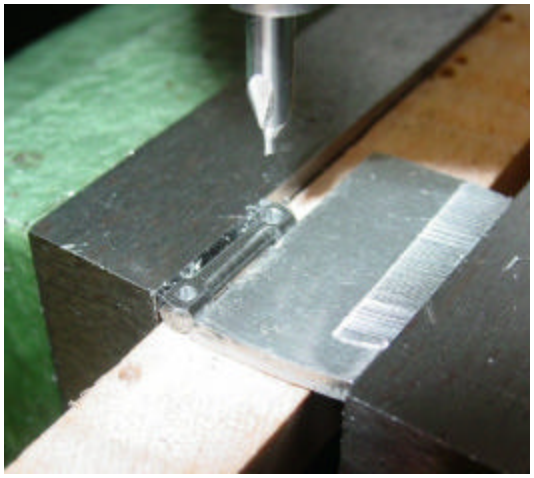
Center drill exhaust ports to keep fins and curved surface from causing the drill to wander…

Drill exhaust ports. Be sure to align them with the flats on the cylinder so ports line up

Machine pocket for ball wit 1/8 dia ball cutter. Drill the side ports.

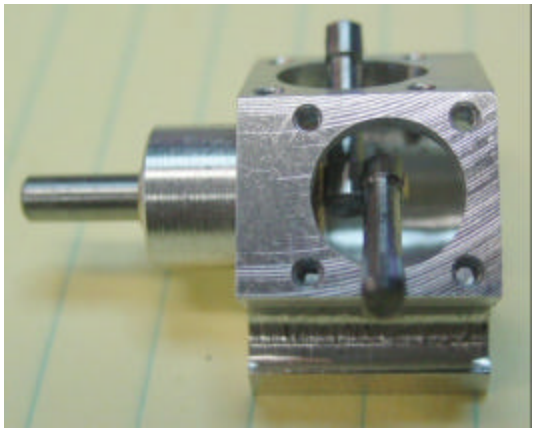
Mil inside of piston, keep 90º to pin hole.


Mill flat sides on connecting rod.


Center drill, drill and ream connecting rod holes.


Most of the parts.

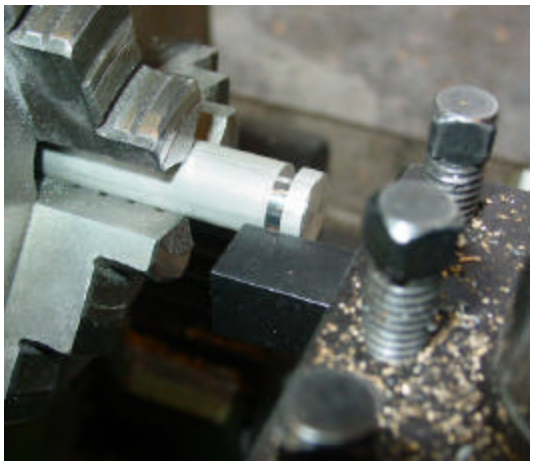

First fitting.


Connecting rods in center or cylinder locations.

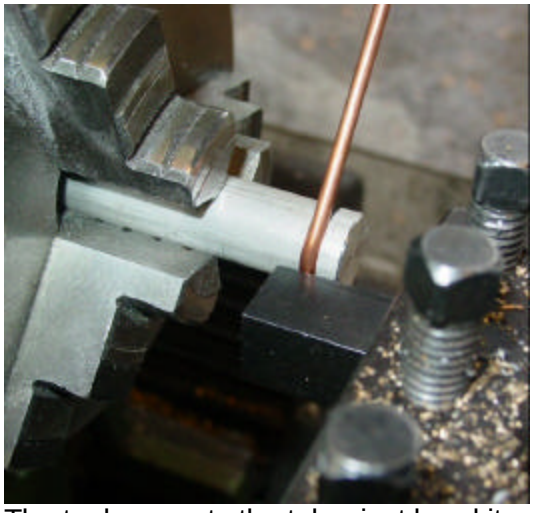
You must be able to get the rod on the crank pin. I had to cut out .010, but the prints have been updated so it will fit.

Just can not wait to see what it will look like.

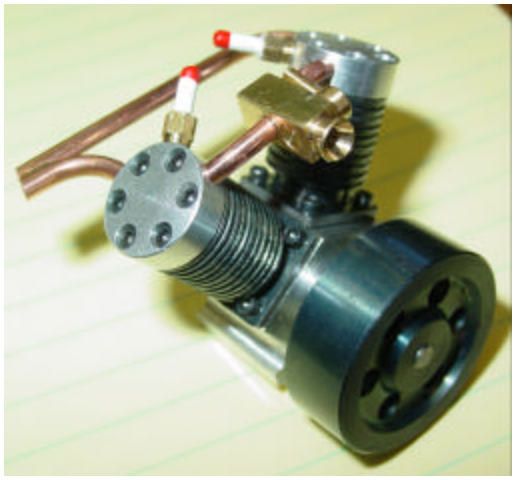
Test each cylinder separately to see it runs. About 50 PSI was needed at first but after 30 minutes it ran great on 35. Don't forget lots of oil at first.

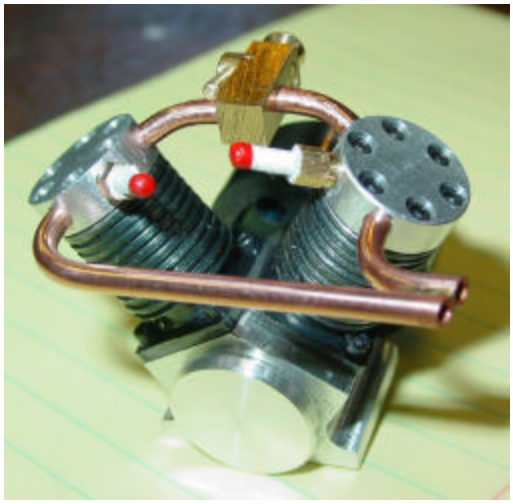


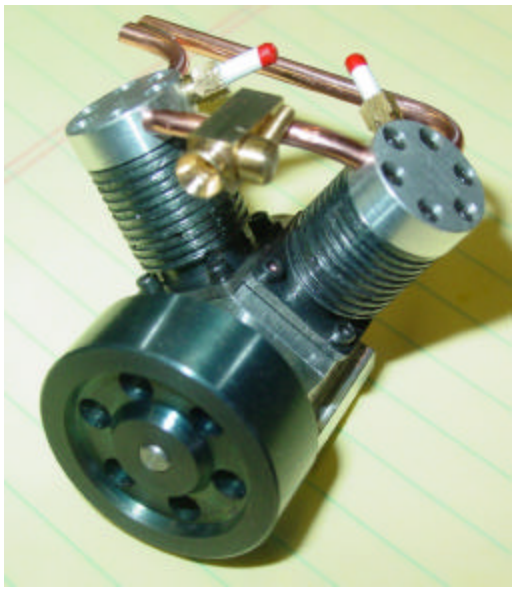
Tube bender, turn a grove the size of the copper tube to bend and move the end of a tool up to the grove.



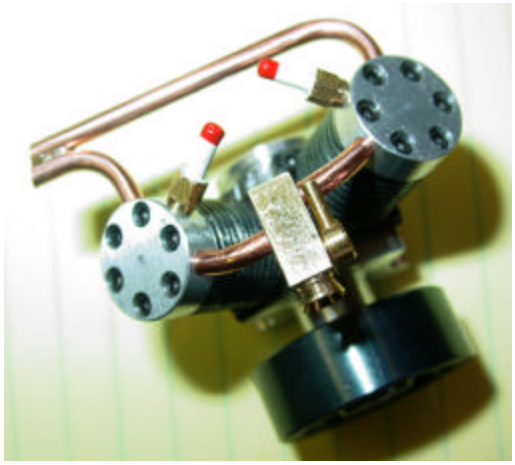
The tool supports the tube, just bend it to the required angle. I adjusted the length on a belt sander.







Finally it is complete. With the throttle, plugs and exhaust pipes.
It runs great and has a different sound with the V timing.



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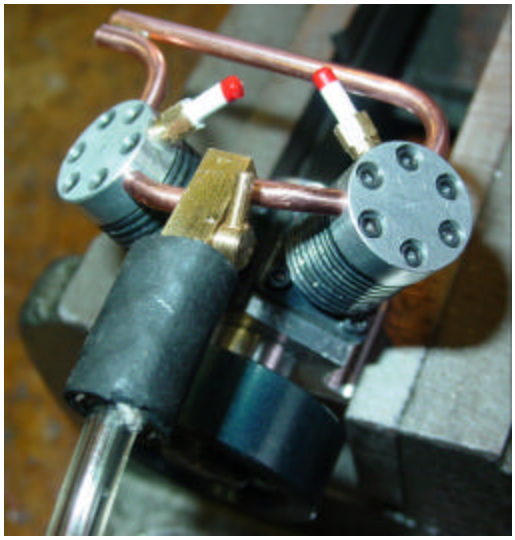

The throttle was a last minute idea. It joins the supply tubes, looks like a carburetor and throttles the speed some. The rubber tube coupling works but not well enough. At 40 PSI it pops off a lot. The trumpet should have had a sharp edge to hold the tube.

A better idea might be to use the exhaust pipes for the inlet.

Final Thoughts: I like the cylinder design and proportions better than the first engine. The angle between cylinders is a little too wide, it looks more like an air compressor.

The fly wheel can get a bit smaller next time as well.

If you decide to build one pleas change things and add your own ideas to your engine.

Design notes:

CO2 engines operate at higher pressures than many people expect. Even though the engines are little they need high pressure to run and it's not about friction in the engine.

When the piston moves up it is compressing the air in the cylinder. This engine has a 2.5:1 compression from exhaust ports to TDC so the pressure peaks at 37 PSI (if there were no leaks). If the supply pressure is less than that the engine will act as a compressor and pump air out. But at 40 PSI or more, the supply pressure keeps the ball seated, when TDC is reached the pin pushes the ball open and increases the pressure in the cylinder to 40 PSI. This is actually only a 2 PSI increase. As the cylinder moves down the air expands and ends up at about 2 PSI when it hits the exhaust port. Very little actual air is used and the engine is almost silent.

When one of these engines operates on low pressures, it indicates the piston/cylinder is leaking and not fully compressing the air.

The pistons must have a good lapped finish in the cylinder to seal so these engines rung well. I recommend drill rod fir the piston. The OD is great. Use an extra length to lap the cylinders to size. Then when the real pistons are fitted they will have a perfect fit. You need to be able to spin the engine with heads off with your fingers on the oily 1/8 shaft.

I lap the balls into the seats with #400 lapping compound and a few spins by hand. The seal is not perfect at first but the engines have always run and after about 15 minutes the valve is leak free.

Have fun, try things and refine your small part skills.