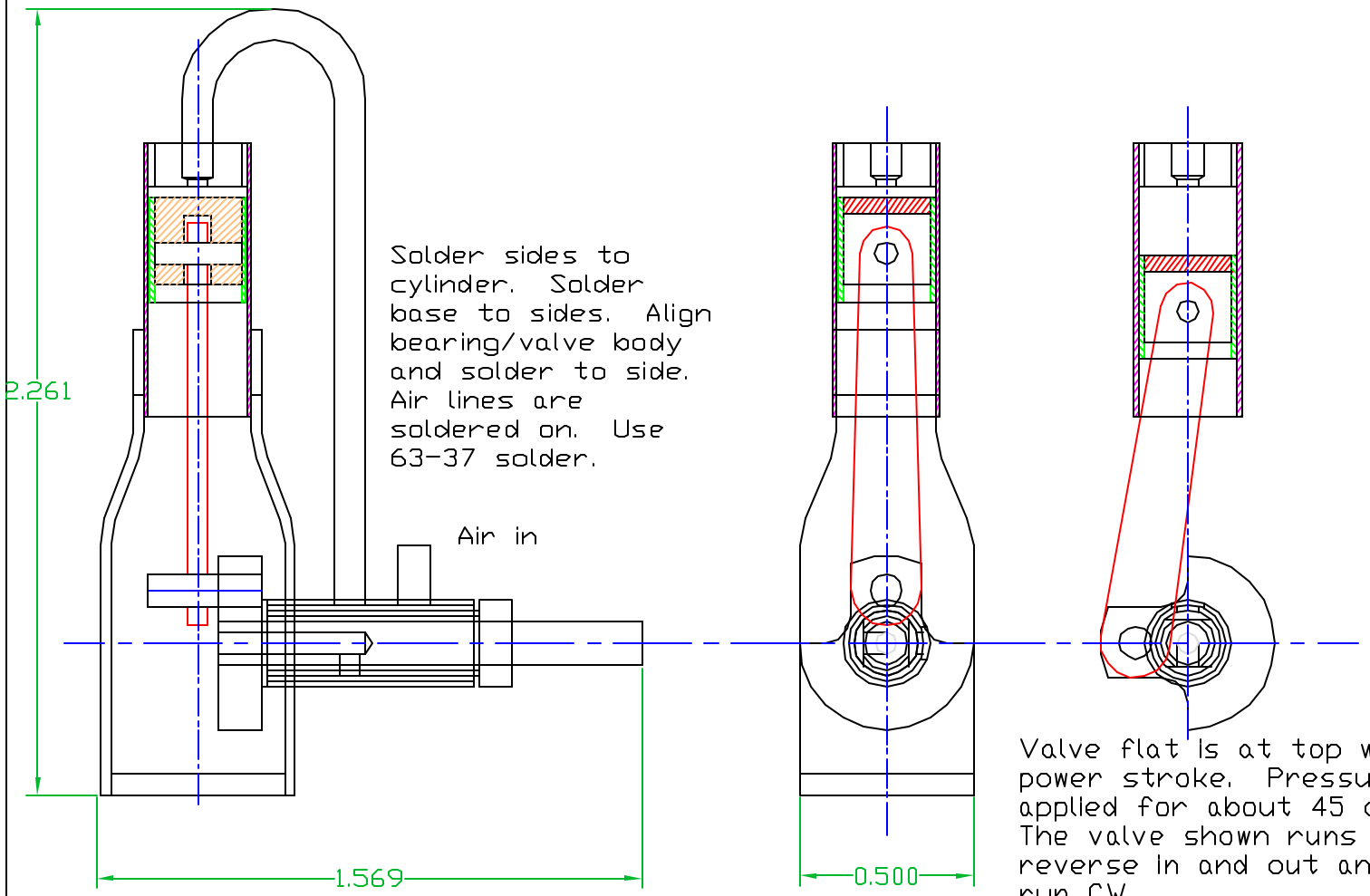


Tube engine is built out of standard hobby shop tubing and hardware store items. The design requires no lathe or mill but they may help improve the appearance.
It was inspired by a 3 cylinder radial design by Joseph S. Ott, in the Model Craftsman Magazine May 1933. It uses a rotary valve to pressurize and exhaust the cylinder. The bore and stroke were reduced and parts were modified for hobby metals.
The rotary valve opens about 30 degrees after TDC and remains open for about 100 degrees. The exhaust is open for about 100 degrees in the middle of the up stroke. This type of valve produces more power and uses more air than the ball and pin design used in C02 engines.

David Kerzel
Pompano Beach, Florida USA

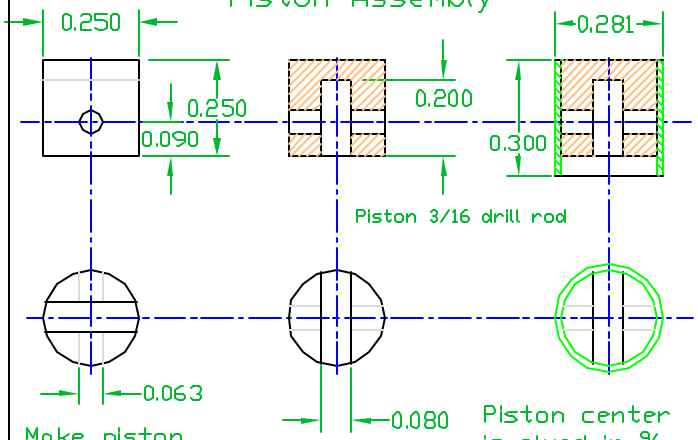
Assembly:
Tube C02, 1 Cylinder

Title:
Overview

Date: 6/7/2004
Revision: 1.0

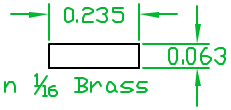
Drawing:
T1_C02-01

Piston Assembly



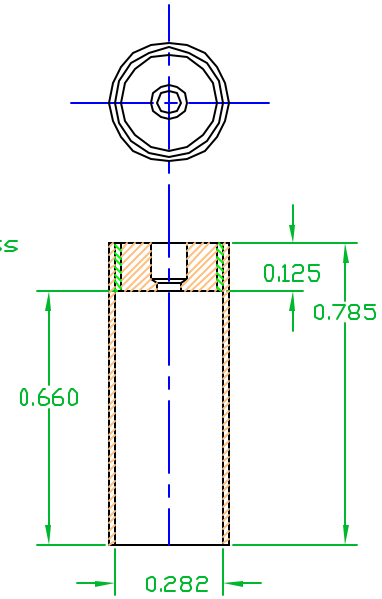
Make piston center from ¼ aluminun rod. Saw slot, drill wrist pin perpendicular to slot.

Piston center is glued in 9/32 dia brass or aluminum tube. Use epoxy or LocTite. Wrist pin is captive.



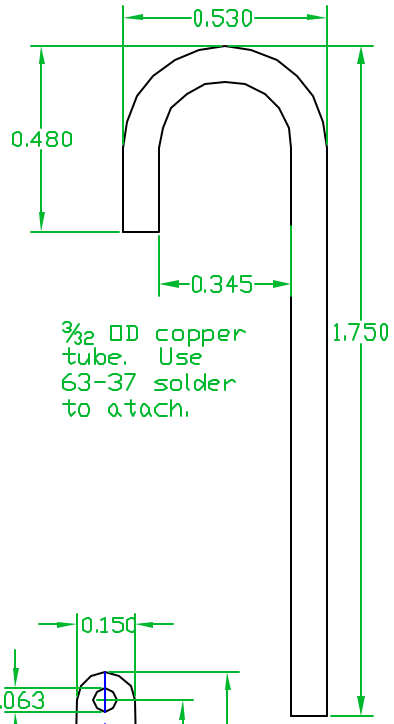
Wrist Pin 1/16 Brass

Center hole for tube is drilled thru 1/16 and counterbored 3/32 X3/32 deep.

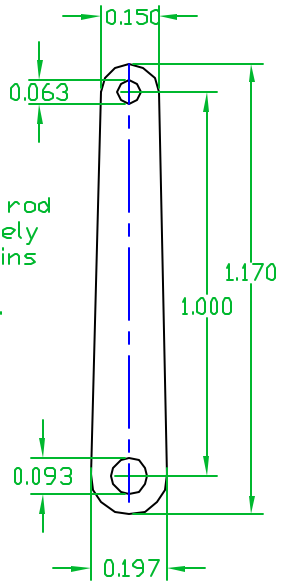


Cylinder is 9/32 ID (5/16 OD) brass tube.
ceter is ¼ OD brass with 9/32 OD tube to fit.

Make a wood plug .660 long to suport the top of the cylinder while soldering with half hard solder.



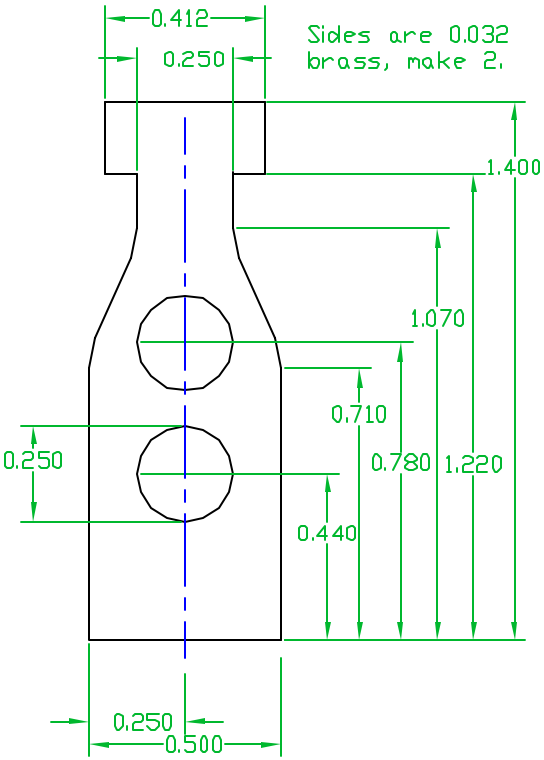
3/32 OD copper tube. Use 63-37 solder to atach.



Make sure conectind rod moves freely on both pins before assembling.

Connecting Rod made from .062 aluminum. Holes or slots can be added to reduce weight or improve looks.

Bend ears to wrap around cylinder. Bend to increase width at base.



Sides are 0.032 brass, make 2.

David Kerzel

Pompano Beach, Florida USA

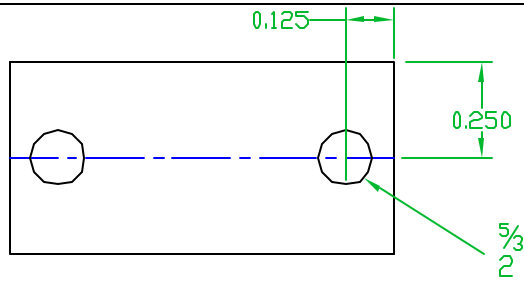
Assembly:
Tube C02, 1 Clyinder

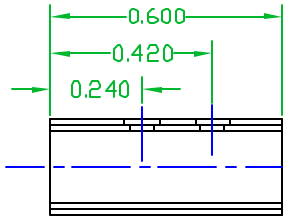
Title:
Piston Cylinder and Rod

Date: 6/6/2004

Revision: 1.0

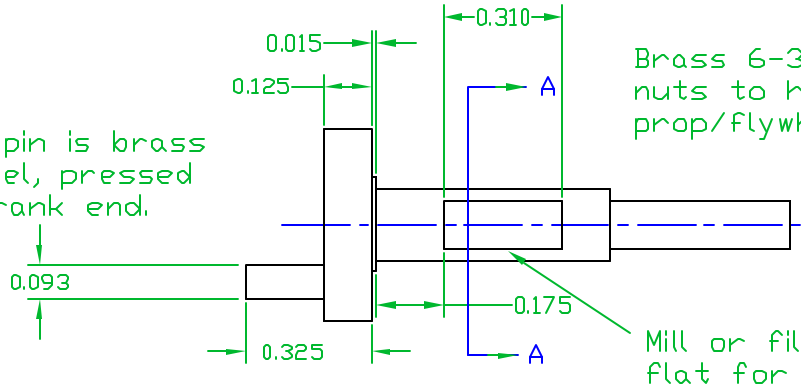
Drawing:
T1_C02-02





Valve body is a section of 7/32 OD Brass tube inside of ¼ OD Brass tube. Side holes are drilled 1/16, then outer tube has holes enlarged to #41 (.096) for 3/32 tube. Holes are allIgned and tubes are soldered together with half hard solder. Air lines are soft soldered into holes.

Base ½ X 1, 1/16 thick brass.

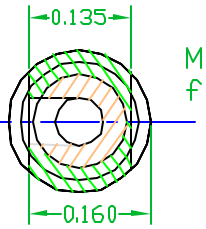


Brass 6-32 brass nuts to hold prop/flywheel.

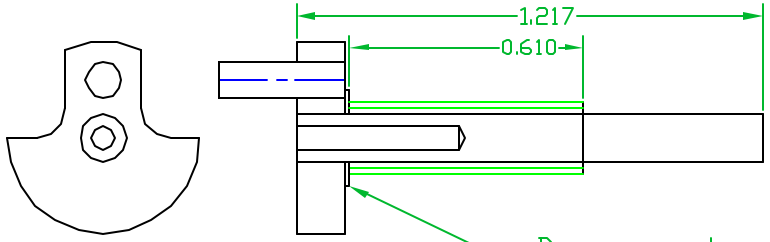
Crank pin is brass or steel, pressed into crank end.

Mill or file long flat for valve.

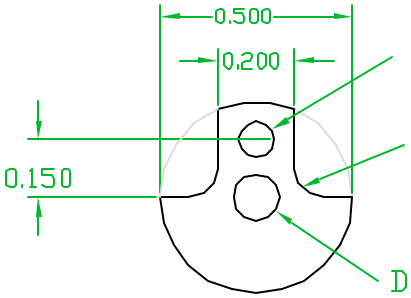
Section A-A Scale 4:1



Mill or file flats for valve.



Brass washer .015 thick, ¼ diameter

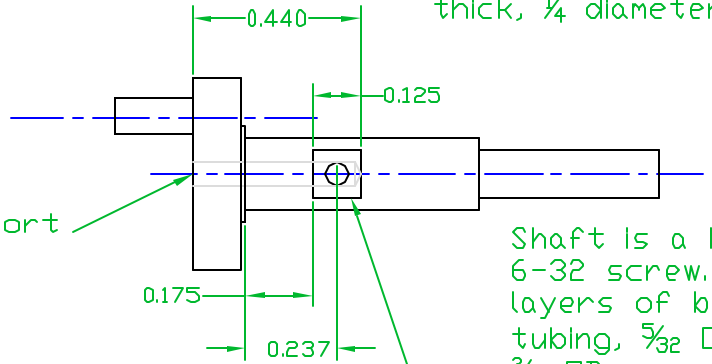


0.093 hole for pin

File or mill a .187 radius

Drill 0.125

0.093 thick brass



Drill exhaust port in center, .440 deep.

Mill or file flat for valve.

Shaft is a brass 6-32 screw. Two layers of brass tubing, 5/32 OD and 3/16 OD, are soft soldered together.

David Kerzel

Pompano Beach, Florida USA

Assembly:
Tube C02, 1 Cylinder

Title:
Crank

Date: 1/4/2005

Revision: 1.2

Drawing:
T1_C02-03

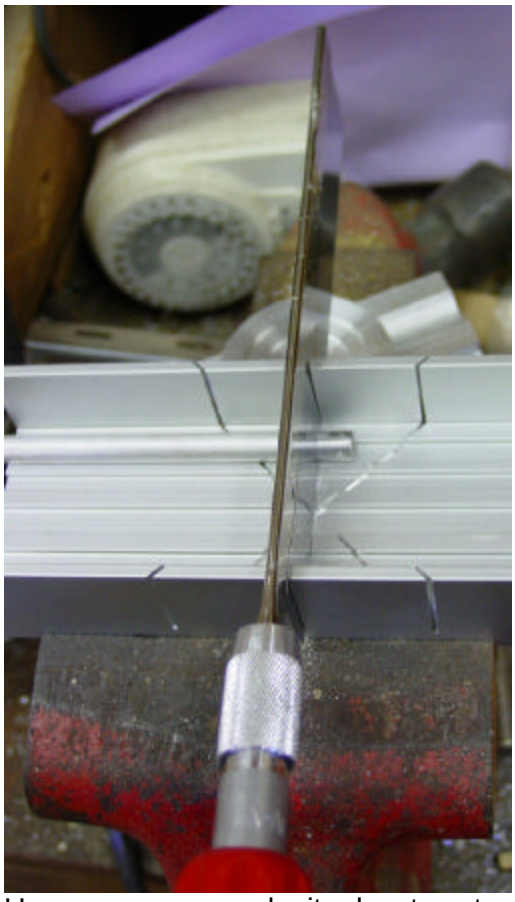
Construction Notes for the Tube CO2 compressed air engines.
7/22/2004

This is a set of photos and notes that should help better understand the parts and drawing used in this engine. The notes are primarily for the single cylinder engine but are also appropriate for the 3 cylinder radial.

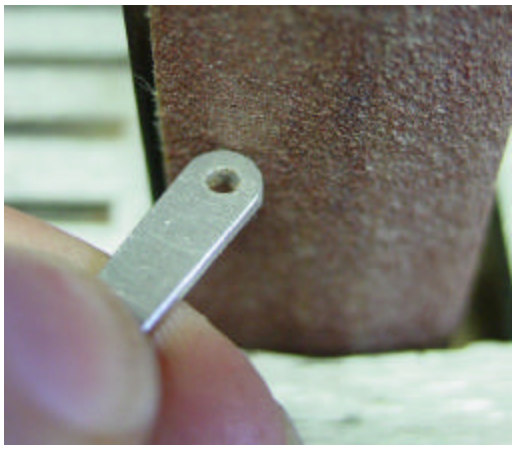
The engine is made from materials available at the hardware store. I used the lathe and mill but it is obvious that with some care this entire engine could be built with a drill press and hand tools.

Cut the slot in the piston rod.

Cross drill the piston at 90 degrees. Do it all in one clamping if possible. Parts are small so center drill everything.



Use a razor saw and miter box to cut the tubes. Be sure to debur everything.

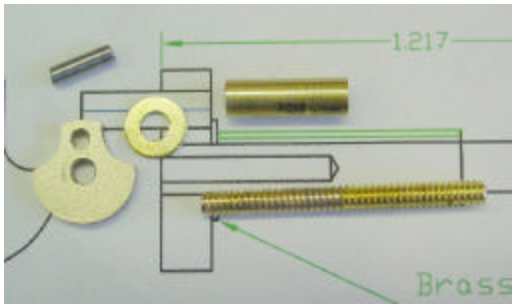


The ends of the connecting rod are just filed or sanded to shape.

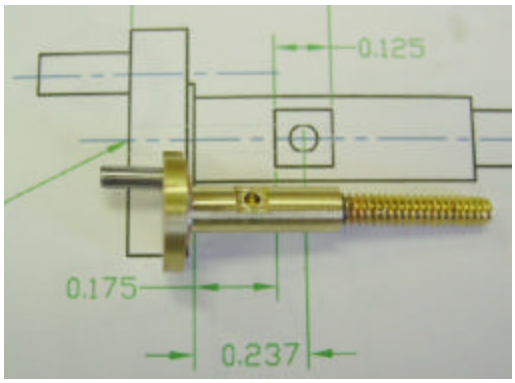
Construction Notes for the Tube CO2 compressed air engines.
7/22/2004

All the piston parts. When the tube is glued to piston center the wrist pin is captive. The connecting rod is tapered to allow it to move over a wide enough angle for the crank.

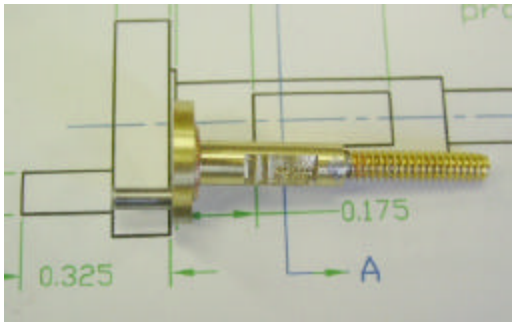
A length of brass had the hole for the crank pin drilled and 2 cuts made for some balance.



The crank is made of the 2 layers of tube, a cut off 6-32 screw. The screw needs to have some of its threads filed down to fit in the first tube. Now is the time to drill the axial hole in the screw for the exhaust. Solder the tube to the screw and the shaft to the crank end.



Make the small exhaust flat. Drill the hole to the center hole.



Flip the shaft and make the longer input flat.

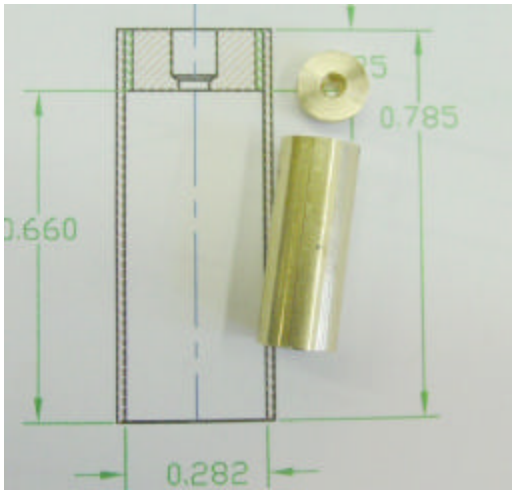
A multi cylinder version needs a way for the input air to reach the valve flat regardless of the shaft angle. This is done by cutting a grove shown on the radial drawing.

Construction Notes for the Tube CO2 compressed air engines.
7/22/2004

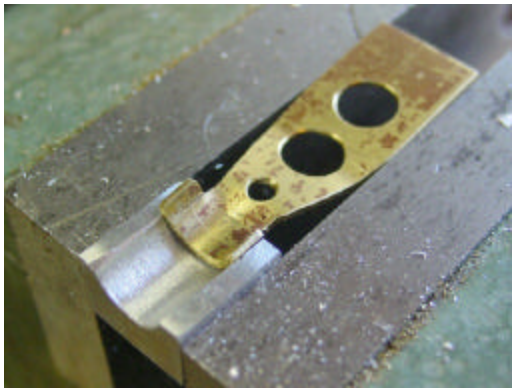
The outer valve body is 2 layers of tube. The inner one is drilled 1/16 and the outer one id driller #41 (.096) to accept the OD of the copper tube to be soldered to it. They get soldered together

For the multi cylinder version, multiple holes are needed for the copper tubes going to the cylinders.

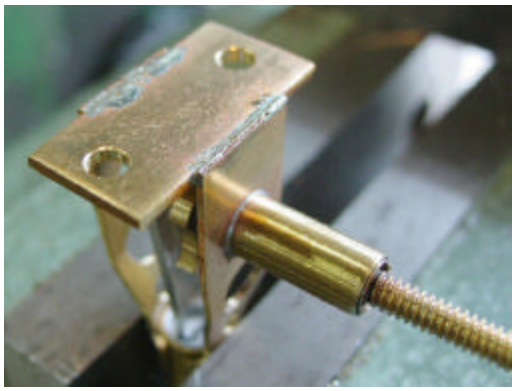
The valve will accept as many tubes as you can add. It may take a few minutes to figure out how it just works.



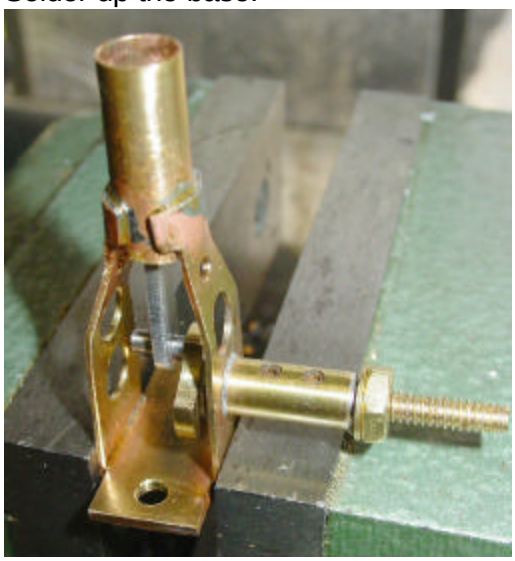
The cylinder is a tube with an end cap made to accept the copper tubes.



The frame sides are cut out. A concave form is made to make the curved areas.

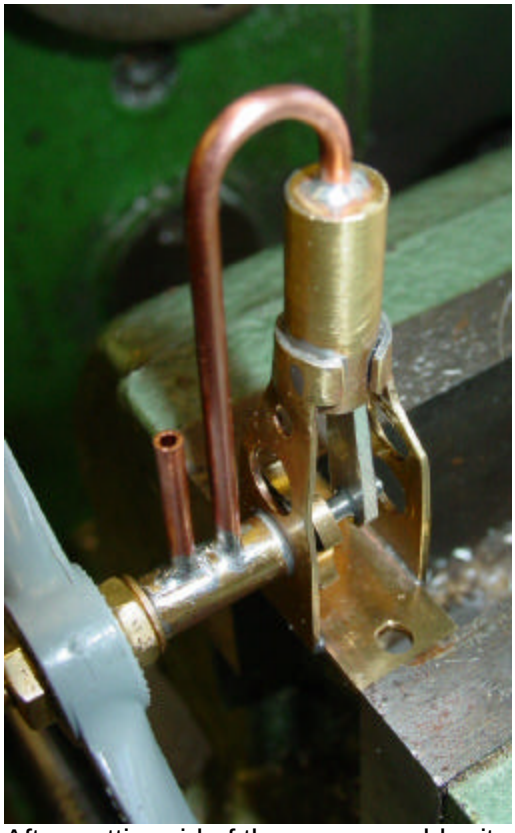


Solder up the base.



Solder the cylinder in place so there is .015 gap inside the cylinder at TDC.

Make a tube bender and form the J.



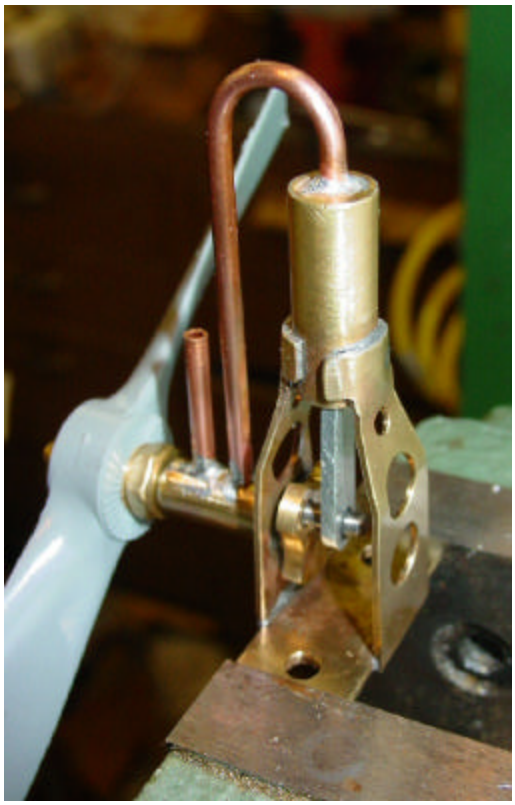
After getting rid of the excess solder it is done.

Initially with the excess solder the J tube was clogged. It would not run.

When the tube was clear, the engine feels very strange. There is no compression, it just spins.

The rotary valve is very simple. At about 30 degrees after TDC the long slot allow the compressed air into the cylinder. The compressed air pushes the cylinder down for about 100 degrees. For the remainder of the down stroke the air expands and continues to push. At about 30 degrees into the upstroke, the exhaust port opens and the piston pushes air out the center or the crank shaft. After about 100 degrees the valve closes to get ready for the next power stroke. The angles are not pecise and the operation of the valve is not exact.

This is a simple and efficient valve.



Looking at his view you can see where 2 more connecting rods would go to make the 3 cylinder radial.

Have fun with this design it is simple flexible and tolerant. Clearances are large but who cares if it leaks a little when it is running great.