Tin Can Stirling hot air engine

Thank you for purchasing the Tin Can plans. I hope they are informative enough to get you through the whole project. If you have any questions email them to [redacted] link.net . I will try to answer them in my free time. Thanks again and have fun.

One note before you get started. When you're working with tin cans its best to wear gloves. These cans can be very very sharp when cut and some of the operations require a little persuading and can easily slip and cut you. Be very careful. Be forewarned I will not be liable for your actions and safety precautions .

I've included the "Stirling Formula" page in case you can't find all the right size cans. You want to make sure you follow this formula fairly close or your engine may not run. Also, the clearance between the displacer piston and displacer can should be as close as you can get it without touching the sidewall. Most of the ones I've put together had about 1/16th to about 1/8th inch clearance depending on the cans. More than 1/8th inch creates a lot of dead space and won't run as well or possibly not at all.

The power piston and cylinder should be a very close fit. You want as little leakage here as possible. I used a 1 1/8th inch aluminum tube with a .062 wall thickness. This allows for a 1 inch piston to fit fairly nice. If you have access to a small machine shop this would be helpful for sizing it. If you don't….. You can find a 1" piece of aluminum (solid) and use sand paper to size it. It should fit snug but travel through the tube without any drag or very little. You can use a light oil to make it slide smoothly.

When gluing the parts together I mention the use of JB Weld. This works very well, there are other brands out there that work well also so if the JB brand isn't available use PC-7 or something equivalent. I use the JB Quick because it sets up in about 4 minutes; the other takes 24 hours to completely set up. Unless you have a lot of patience and a lot of time to hold parts use the JB Quick.

Drawing 3 shows the Burner pot made from a coffee can. It states to use Hi temp silicone around the top edge. You want to make sure the cylinder and displacer can is positioned in the motor mount board prior to doing this. If you glue it without positioning it in the motor mount the burner pot could be to high or too low. There is no real need to seal this can if you choose not to. If you do decide to seal it and lock it in place do it after the unit is mounted.

Drawing 4 shows the "Cooling can" made from another coffee can. This unit can be installed prior to mounting the engine and you should check it for leaks. You will put water, ice or snow in it to keep the cold side cold. The colder you can keep it the faster it will run.

Drawing 5 shows the "Displacer piston". This is made from 2 beer can bottoms. When pressing the two pieces together use some JB to assure a good seal and that the parts

won't come apart when running. Try to get the center hole as close to center as possible. If you're off by a little it could mean the piston will drag along the displacer cylinder wall and create friction not allowing it to run properly. Instead of threading the rod you can use JB weld to seal both openings where the rod will be inserted. If you have a threaded end use a nut and JB weld to hold it. This is just a precaussion to assure the rod and can won't come apart.

Drawing 6 shows the Displacer can top and rod bushing. This is made of a bolt with a 1/8th inch hole drilled down the center. You want to make sure the rod slides freely through the hold without binding and also not sloppy enough to create a leak. This rod gets light oil for lubrication and sealing.

Drawing 7 shows the placement of the Displacer can top. I usually smear some JB weld around the can top inside and around the larger piece where the can will contact the can then slide the unit together. Its best to insert the unit without any JB first and work the displacer rod and piston up and down to make sure there are no binds or dragging going on. This is the time to find them … after its glued you can't fix it. After the top is pushed into place and glued mix up a batch of JB and smear it around the outside allowing it to build up so no edges are showing. After the JB has set up blow into the power piston hole and listen for leaks, If you hear a leak find it and seal it with JB again.

Drawing 8 shows the sizes of the wood base, backing, engine mount etc. These are basically a general layout and none of the dimensions are set in stone. If your cans are different in size then you must cut the wood accordingly. The same is true for Drawing 8.1

Finalizing you motor with the rods. I used all 1/8th inch brass stock and threaded the ends and made my own ends. An easier way would be to visit your local Hobby shop and use the rods they have already made up. They also sell the slick little threaded ends that screw right on. The timing is set already because the displacer rod and power piston is set at 90 degrees from each other and the mounting on the flywheel is shared by both rods.

The following are some pictures that will aid in the placement of the rod connections and other parts. Notice this engine has separate mounts for all the different components. The better way is to combine the mounting brackets into two pieces. This motor is shaky when running at high speeds. When all the mounting boards are combined this cures the problem.

This shows the configuration of attaching the displacer

rod. This was done using a 1/8th inch brass welding rod bent to line up with the walking beam. You must use a link to keep the geometry correct otherwise a direct connection will cause the displacer rod to bind.

The rod ends don't have to be threaded, you can drill through a small piece of plastic, aluminum or whatever you have and glue with JB weld. Also, ends could be made from an L bracket material of some sort. Let your creativity flow… this isn't a precision piece of machinery only a sample of how easy it is to make one of these engines.

This picture shows the general layout, front and back view of the machine.

I'm not sure if it helps but they say a picture is worth a thousand words so here is the top view for reference.

This is a view of the piston and rod. A basic straight blade screwdriver screw is threaded into the piston. The screw has a brass tube attached to it for mounting the piston rod. This can be soldered, brazed, or even glued with JB weld. Make sure all the connections are cleaned and sanded.

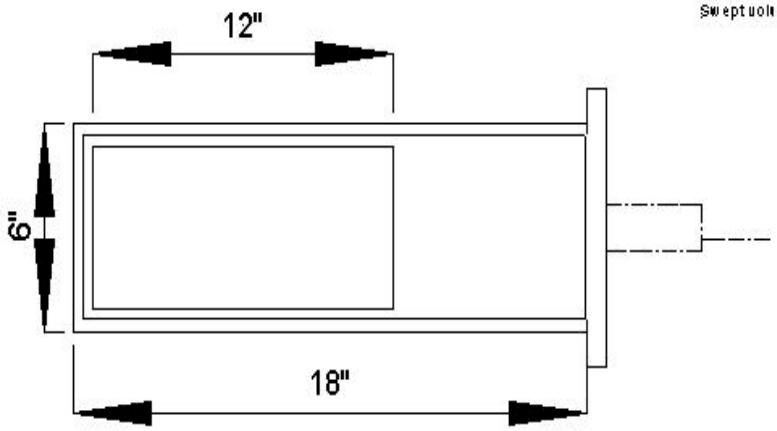
This is a basic view of the crankshaft/flywheel connections along with the piston connection.

Well… get started…. Have fun and be creative… remember nothing here is set in stone a few alterations won't change the way it runs.

If you find you have a problem figuring something out and it's not in here please let me know and I will try to clarify it for you and add it to the next set. Thanks and once again have fun and always remember SAFETY FIRST.

Edwin Lenz

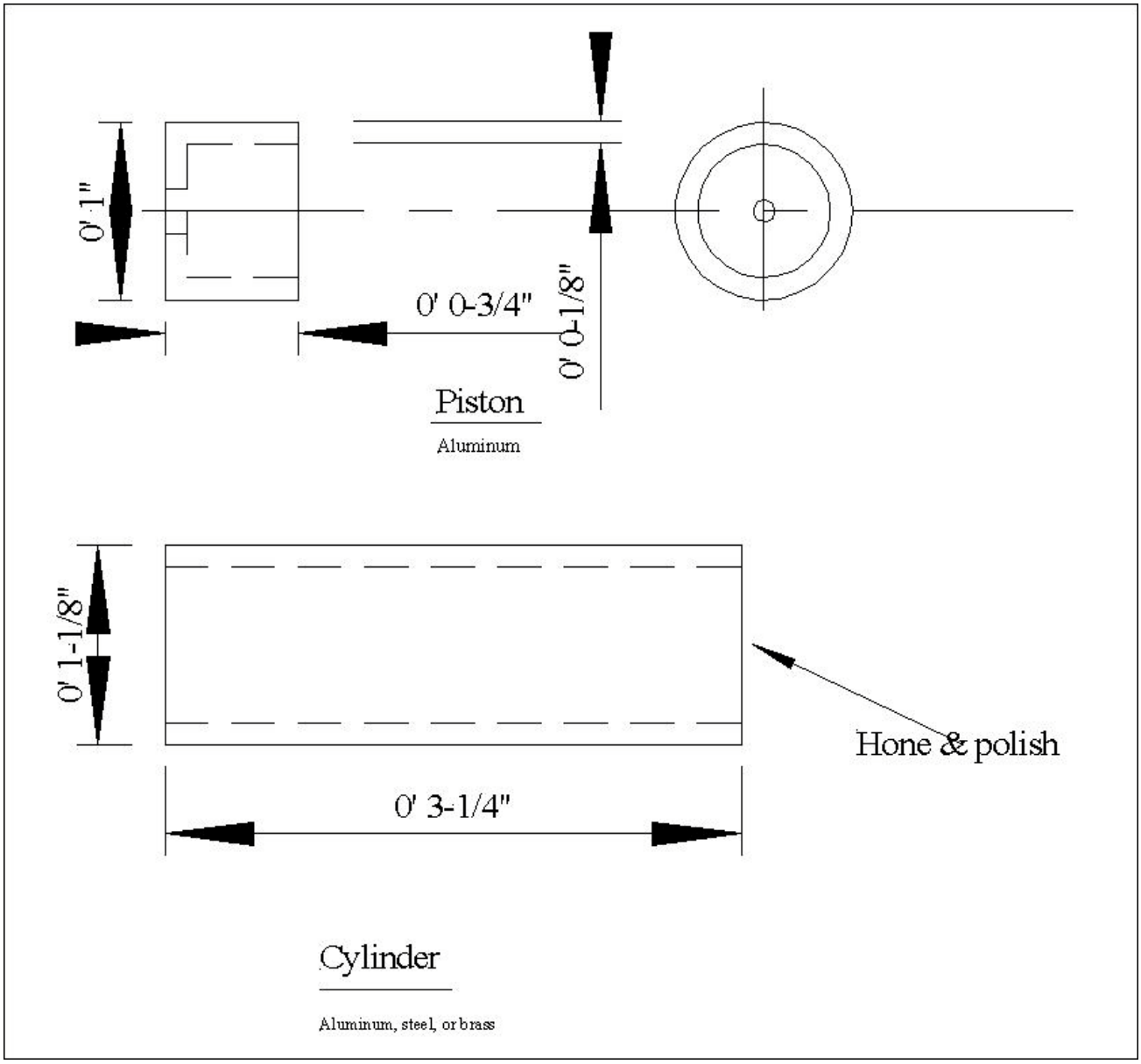
Swept volume



1. The length of the displacer chamber = 3 times its diameter
2. The length of the heated chamber = 2/3 of the length of the displacer chamber (cylinder)
3. The length of the cooling chamber = 1/3 of the length of the displacer cylinder.
4. Swept volume of the displacer = 1 1/2 times the swept volume of the power piston.
5. Length of the displacer = 2/3 of the length of the displace cylinder.
6. Stroke of the displacer = 1/3 of the length of the displacer cylinder.

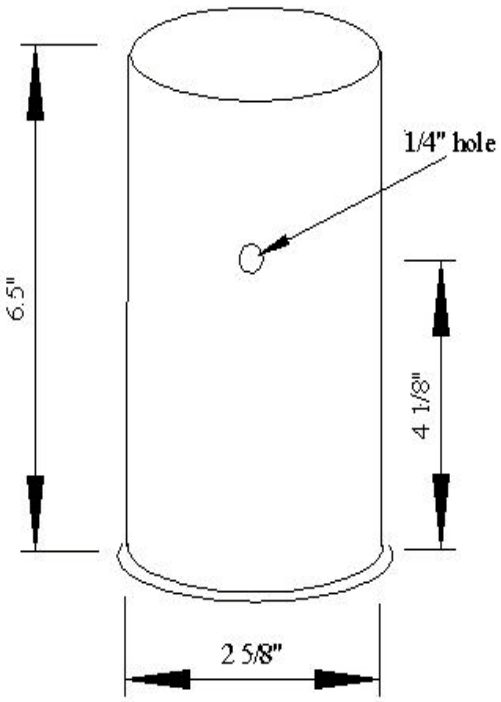
Swept volume = Bore ^{2} x stroke (length) x .7865 x # of cylinders

Drawing: Formula for stirling engines	Date: 11/24/96
Design by: Edwin W. Lenz	

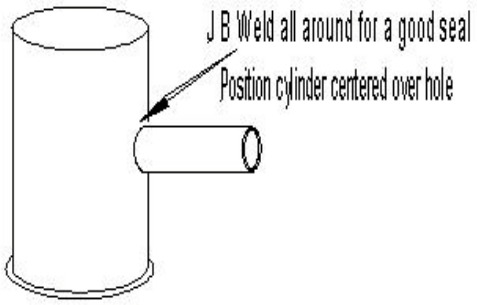

0' 1"
0' 0-3/4"
0' 0-1/8"
Piston
Aluminum
0' 1-1/8"
Hone & polish
0' 3-1/4"
Cylinder
Aluminum, steel, or brass

Displacer Cylinder

Cut top off can carefully!



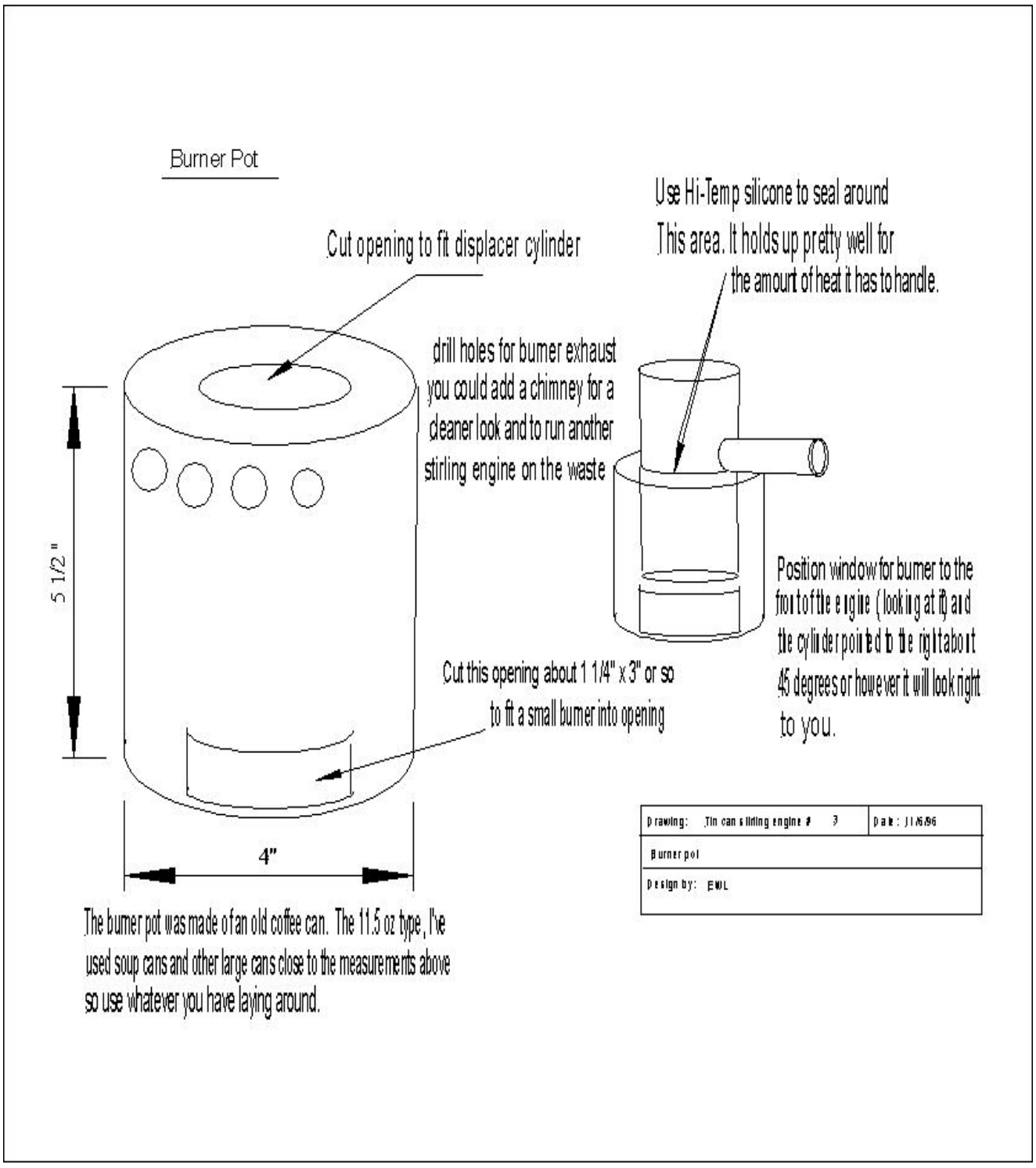
The can you use can be of almost anyone that matches the dimensions closely. I used an engine cleaner and degreaser can

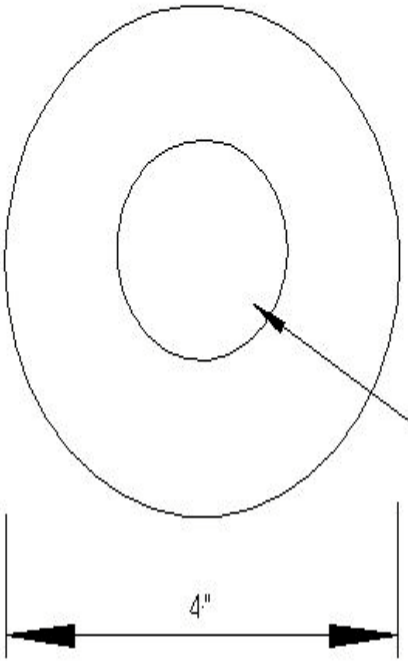


NOTE;

Rough up area on displacer cylinder around the 1/4" hole you drilled for the opening to the pistion cylinder and also the piston cylinder so the J B Weld has a better bonding surface. If you use the "J B quick weld it will be set in about four minutes and you can move on to the next operation more quickly!

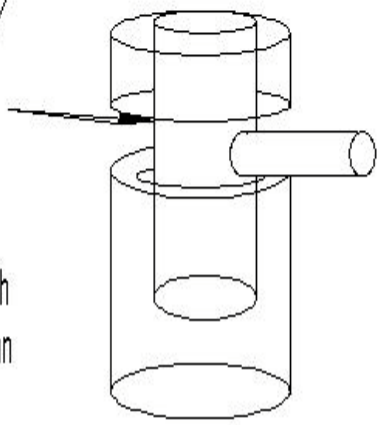
Drawing: Tin can Stirling engine	Date: 11/5/96
Design by: EWL	


Burner Pot
Use Hi-Temp silicone to seal around
This area. It holds up pretty well for
the amount of heat it has to handle.
Cut opening to fit displacer cylinder
drill holes for burner exhaust
you could add a chimney for a
cleaner look and to run another
stirling engine on the waste
5 1/2"
Position window for burner to the
front of the engine (looking at it) and
the cylinder pointed to the right about
45 degrees or however it will look right
to you.
Cut this opening about 1 1/4" x 3" or so
to fit a small burner into opening
4"
Drawing: Tin can stirling engine # 3
Date: 11/5/96
Burner pot
Design by: EWL
The burner pot was made of an old coffee can. The 11.5 oz type, I've
used soup cans and other large cans close to the measurements above
so use whatever you have laying around.



Cut opening to match opening on displacer can

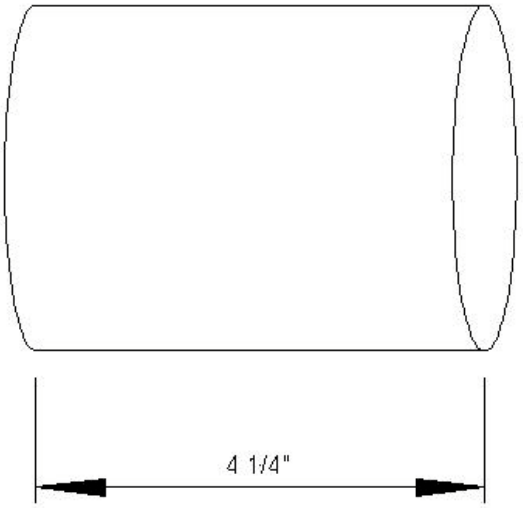
Use J B Weld around outside on bottom to glue to displacer and silicone around inside to assure water tight seal.



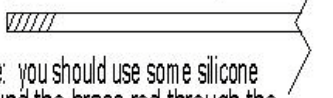
Another coffee can bites the dust.... same as the burner pot only cut down to about an inch an a half tall, use the bottom of the can and cut a hole to match the size of the displacer Cylinder can. It should be fairly close (as possible) but not tight enough in any area to distort the roundness of the can. This has to be glued to the can and sealed to retain water.

Drawing: Tin can stirling engine #4	Date: 11/7/96
Water cooling jacket can	
Design by: EWL	

Start with 2 cans...(I used 2 coors light cans)... cut one can to 4 1/4" tall then cut the bottom off the other can to about 3/8". Then, press the shorter bottom piece into the larger bottom piece to form a sealed can.

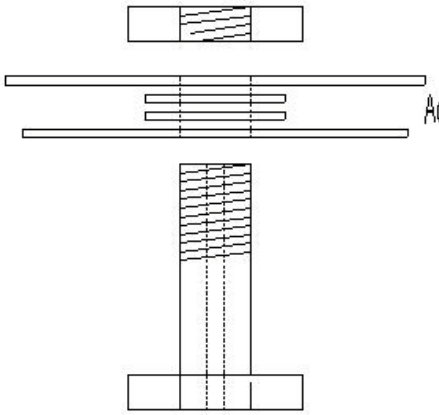


Thread the end of a 1/8" brass rod (or brazing rod) Drill 1/8" hole through the top and bottom of the Displacer-directly through the center. Slide the threaded rod through the holes and place a nut on the bottom side then J B Weld the top of the rod into place. After the J B sets up snug the nut in place. You will cut the rod to length later.



Note: you should use some silicone around the brass rod through the bottom to assure that the displacer is a sealed unit. Then install the nut.

Drawing: Tin can stirling engine #5	Date: 11/7/96
Displacer piston assembly	
Design by: EWL	



These plates can be made from any sheet metal... aluminum, steel, etc. The top should fit just over the opening of the Displacer chamber and the bottom one should fit just inside.

Add 2 washers here for spacers (to fit the bolt you use)

5/8" bolt about 1 1/4 long (approx). Drill the center 1/8" all the way through for the displacer rod.

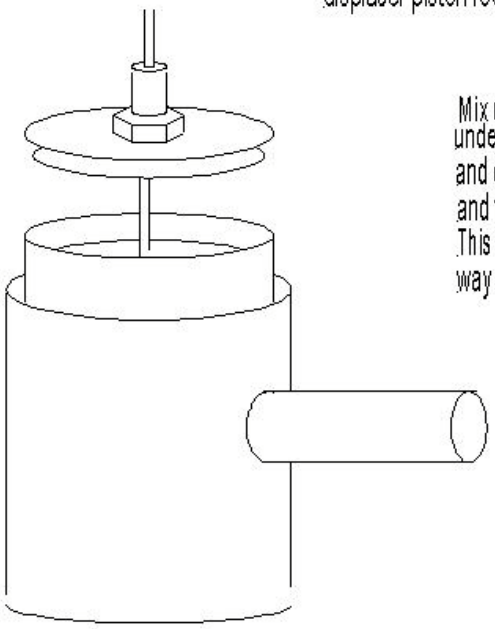
NOTE: USE SILICONE SEALER ON BOLT HEAD AND NUT DURING ASSEMBLY TO ASSURE THAT THE DISPLACER TOP IS A SEALED UNIT.

Drawing: Th can stirling engine #6	Date: 11/7/96
Displacer chamber cover and displacer rod guide	
Design by: EWL	

Slide the displacer piston assembly into the displacer Chamber

NOTE: Make sure the displacer piston does not hit any sides of the displacer chamber prior to gluing assembly together. There will be no way of correcting this problem after it is glued and set and you will have to start over.

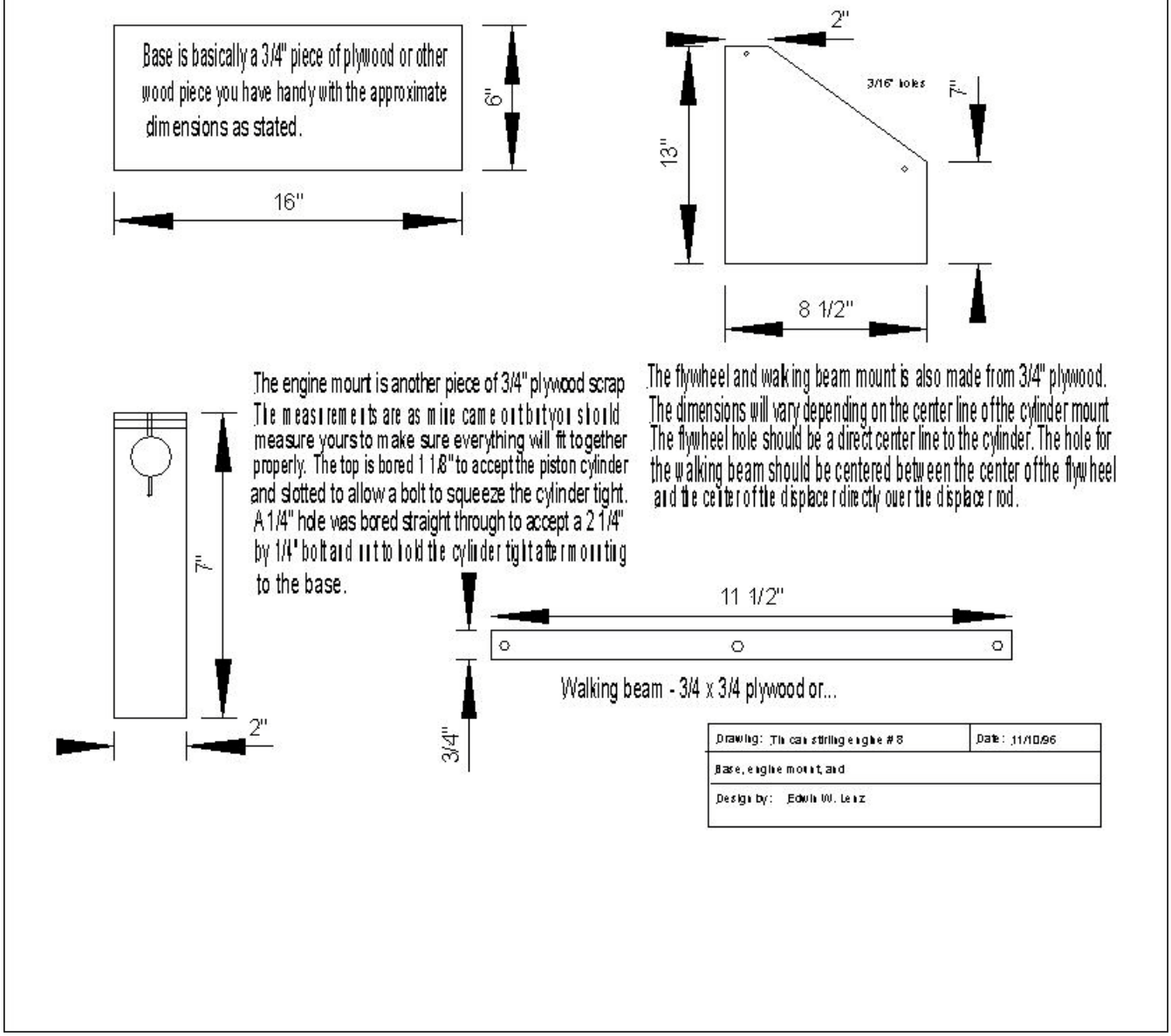
Slide the top assembly over the displacer piston rod

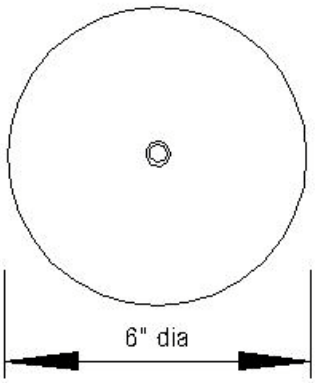


Mix up some J B Weld and smear a small amount under lip of top and press together. Mix more J B and coat the outer edge of can and top together and form a fillet around the entire top and can. This must completely seal with NO LEAKS all the way around the circumference.

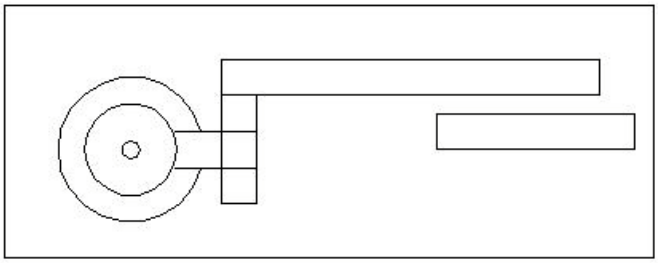
You can check for leaks after the J B has completely set by sucking or blowing into the end of the piston Cylinder. If there are then track them down and repair them. This is a critical point!

Drawing: Tin can stirling engine #7	Date: 11/7/96
displacer piston and top assembly	
Design by: EWL	


Base is basically a 3/4" piece of plywood or other wood piece you have handy with the approximate dimensions as stated.
6"
16"
2"
3/16" holes
7"
13"
8 1/2"
The engine mount is another piece of 3/4" plywood scrap The measurements are as mine came out but you should measure yours to make sure everything will fit together properly. The top is bored 1 1/8" to accept the piston cylinder and slotted to allow a bolt to squeeze the cylinder tight. A 1/4" hole was bored straight through to accept a 2 1/4" by 1/4" bolt and nut to hold the cylinder tight after mounting to the base.
7"
2"
The flywheel and walking beam mount is also made from 3/4" plywood. The dimensions will vary depending on the center line of the cylinder mount The flywheel hole should be a direct center line to the cylinder. The hole for the walking beam should be centered between the center of the flywheel and the center of the displacer directly over the displacer rod.
11 1/2"
3/4"
Walking beam - 3/4 x 3/4 plywood or...
Drawing: Tin can stirling engine # 8
Date: 11/10/96
Base, engine mount, and
Design by: Edwin W. Lenz



Flywheel is made of 3/4" plywood and cut to a 6" diameter. a 3/16" hole bored in the center. I found, though, after about 6 hours of run time the center hole of the flywheel begins to open up and the flywheel begins to wobble a bit. To cure this problem I redrilled the center to 3/8" and installed a brass bushing with a 3/16" hole. I have about 30 hours run time on my engine as these



The placement of parts on the base will be determined by your engine and the cans you used but for the most will be basically the same. Start by taking the engine mount and nail, glue or screw it to the flywheel/walking beam mount. Then find a center placement for the mount and engine to fit on the base and mount them together (nail, glue or screws). Assemble the mount to the base and the engine to the mounts. Then we can proceed to the rods and connectors.

The 1/4" hole for the engine mount will have to be drilled through the main mount to accept bolt to hold the engine in place at this point.

Drawing:	tin can stirling engine #9	Date:	11/11/96
Flywheel and Assembly orientation			
Design by:	Edwin W. Lenz		