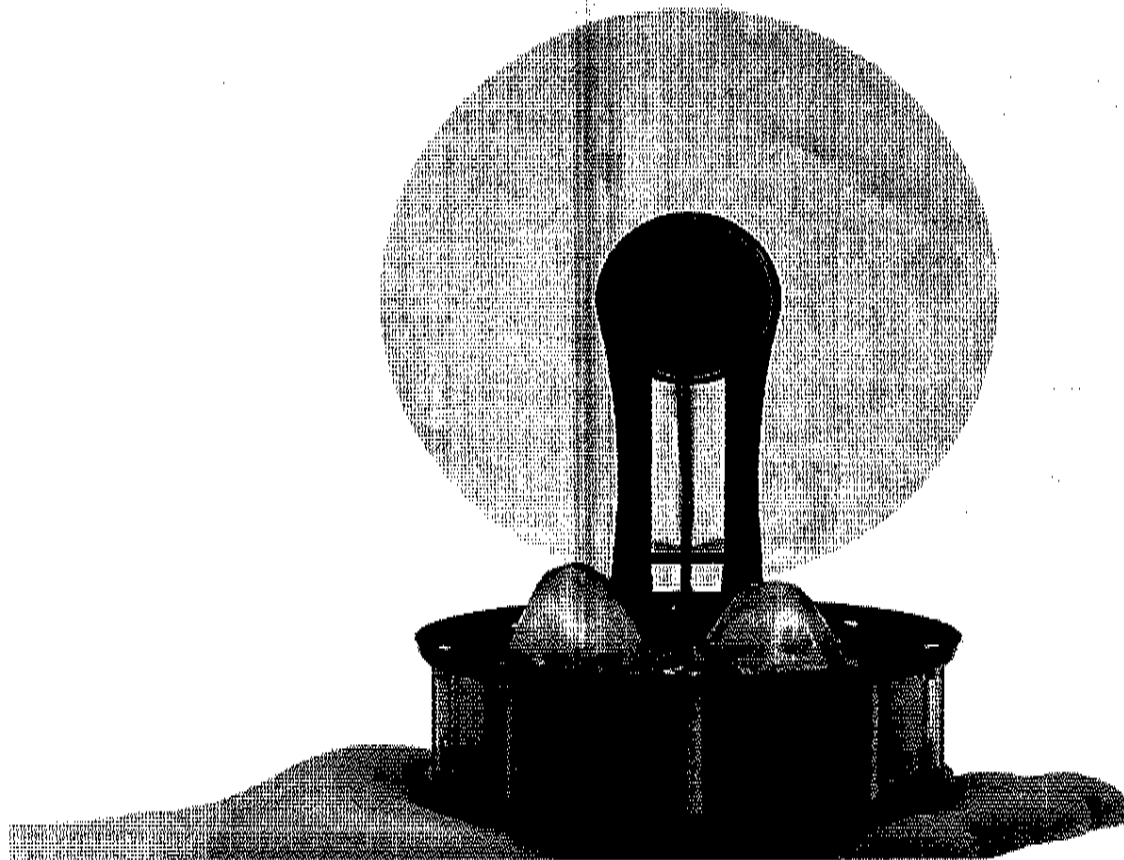


Inpro Solar HAND STIRLING 6565

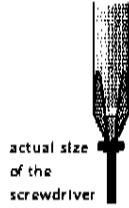
Instructions for Assembling and Operation



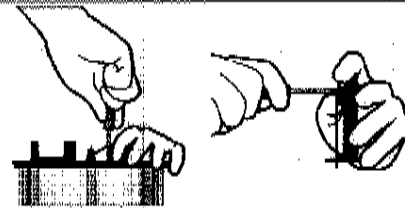
This Stirling Engine kit runs on the expansion and contraction of the air. No need of fire or fuel. This very unique engine's performance is greatly influenced by the leak of the air or friction. Please read the following instructions carefully, and assemble in order.

Hints on Screwing

How to screw is the most important point of assembling this kit. The screws we use are self-tapping screws that create helix when driven in and the self-tapping screws must be screwed precisely. Let's check the basics of screwing before we go to the next process.

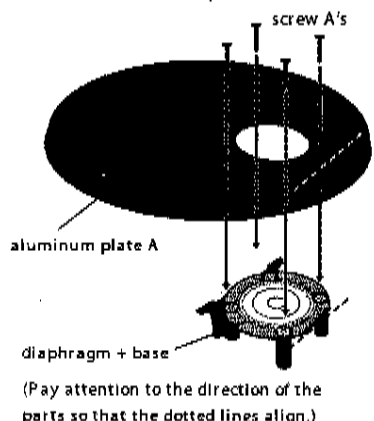


The basics of the basics of screwing are to choose the right size screwdriver. A smaller screwdriver needs more power to turn and smashes the slot.

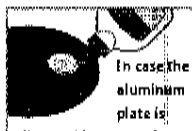


When screwing, press the screwdriver to a screw vertically and turn. The proportion of the power is 70% for press and 30% for turn. Too loose screwing causes leak of air. On the other hand, too tight screwing causes the distortion of the aluminum plates. Try to screw moderately.

4. Attach the diaphragm and the base assembled in 3 to the aluminum plate A with screw A's.

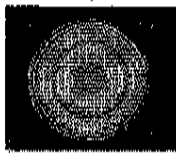


Put the screw holes in the aluminum plate A and in the base together and insert all four screws in the holes. Make sure the screws are vertical and then screw to fasten. Read the Hints on Screwing above before screwing.

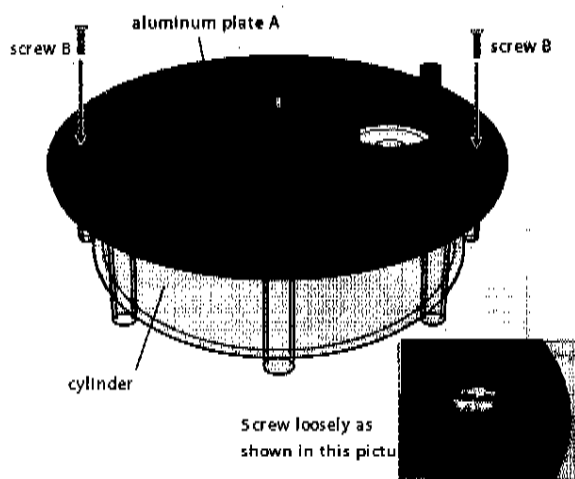


In case the aluminum plate is distorted by too much screwing, apply some wood glue to the gap between the aluminum plate A and the diaphragm to prevent the leak of air. Do not apply too much glue.

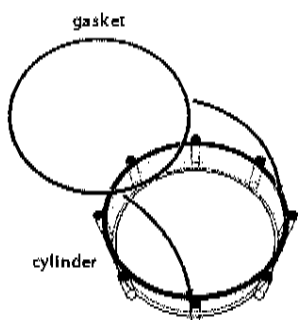
As you screw slowly, the diaphragm begins to warp. Stop screwing at that point.



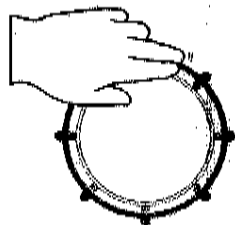
7. screw temporarily at two diagonal points



5. Attach a gasket to the cylinder.

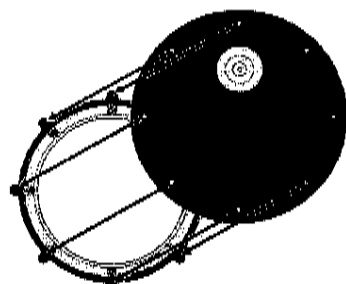


Put a gasket in the groove of the cylinder. Put the gasket on the groove first and then push lightly with your fingers to fit the whole part in.



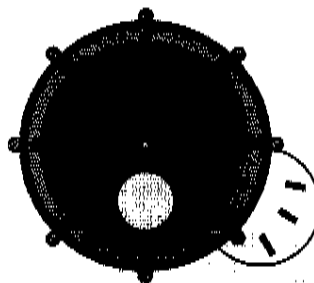
*There is no distinction between the top and bottom of the cylinder.

6. Put 1 on 2.



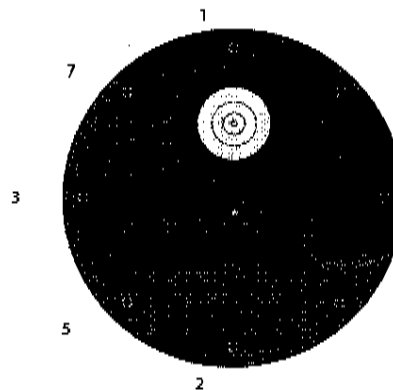
Put the aluminum plate on the cylinder so that the each eight holes in the cylinder and in the plate fit.

8. Make sure the gasket is in the right place



If the gasket is out of the place as shown in the figure, unfasten the screw B and do over again.

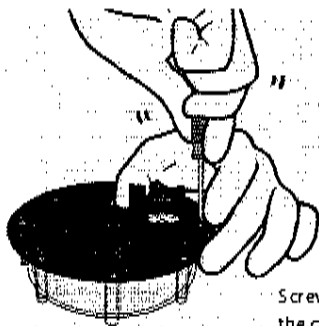
9. Drive the rest screws loosely. Screw in the order shown in the figure to fasten equally.



Pay attention not to drive any screw to tight, or the holes may get out of position and the screws may go slantwise.

Hand Stirling 6565

70 Tighten all the screws.



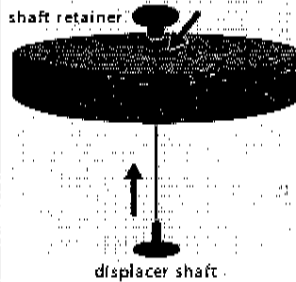
* The paint around the screw may come off but it is all right functionally.



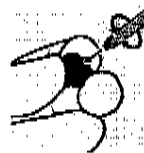
Screw until no space is left between the cylinder and the aluminum plate as shown in the pictures above. Pay attention not to screw too much or the aluminum plate will warp.

Assembling the Displacer

71 Put the shaft retainer in the hole in the sponge disk and put the displacer shaft through the holder from the other side.

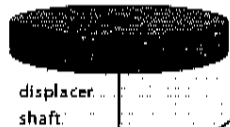


Push the shaft firmly into the shaft retainer to hold the sponge disk. For easy assembling, make the hole in the retainer larger with a screwdriver in advance.



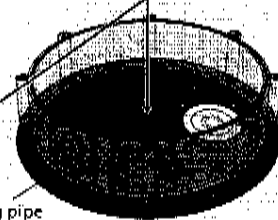
72 Check the displacer.

Insert the displacer shaft into the shaft retaining pipe carefully.

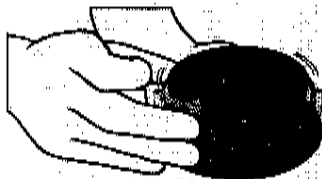


displacer shaft

* If you feel friction as you insert the shaft, move the shaft up and down to scrape clean the pipe. Pay attention not to bend the shaft.

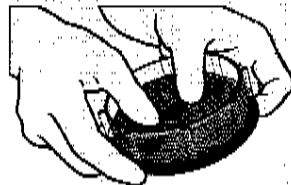


shaft retaining pipe



Put fingers under the displacer shaft to move up and down while turning the displacer, and check if the displacer touches the cylinder. Remove the displacer after the check.

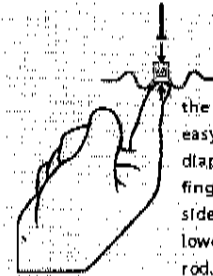
* In case the displacer even slightly touches the inside of the cylinder, adjust the position of the shaft at the center of the sponge with your fingers.



Inpro Solar

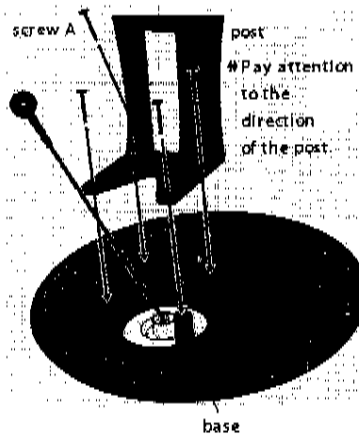
Attaching the Post

73 Attach the link rod to the diaphragm.



Insert the link rod into the center hole in the diaphragm. For easy insert, press the diaphragm with a finger from the back side and hold the lower part of the link rod.

74 Attach the post to the base with four screw A's.

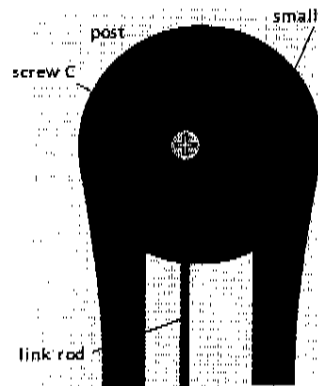


* Pay attention to the direction of the post.

The holes in these parts are made a little bigger for the size of the screws because these parts are made of hard plastic material. Pay attention not to tighten the screws too much. Turn the screws lightly first. When you begin to feel the resistance, turn more slowly until the parts attaches tightly checking from the side.

* It is difficult to tighten the post-side screws with a short shank screwdriver. Don't mind if the screws go a little bit slantwise, or else, change the screwdriver to a longer one.

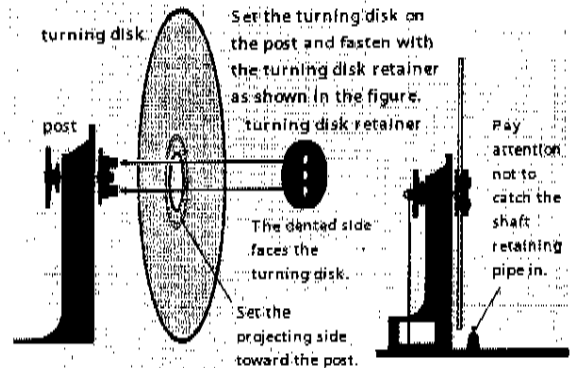
75 Fasten the link rod to the pulley at the back of the post.



Put a screw C through the hole in the link rod and then screw it in the hole which is not closer to the small projection. Screw until the whole thread goes in looking from the side.

* Be careful not to take screw D as screw C. The thread of the screw C ends halfway.

76 Hold the turning disk with the turning disk retainer.



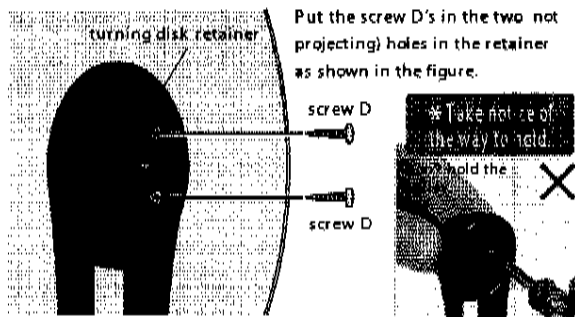
Set the turning disk on the post and fasten with the turning disk retainer as shown in the figure.

Pay attention not to catch the shaft retaining pipe in.

The dented side faces the turning disk. Set the projecting side toward the post.

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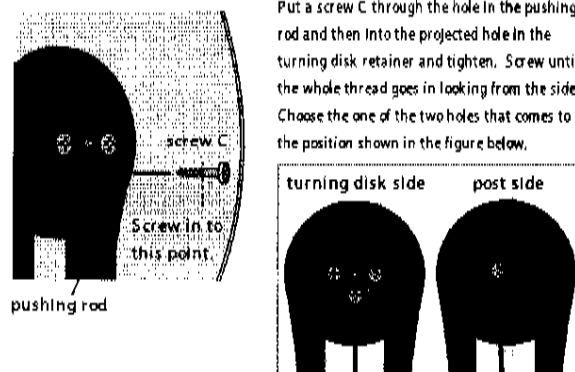
172 Screw the turning disk retainer.



Put the screw D's in the two not projecting holes in the retainer as shown in the figure.

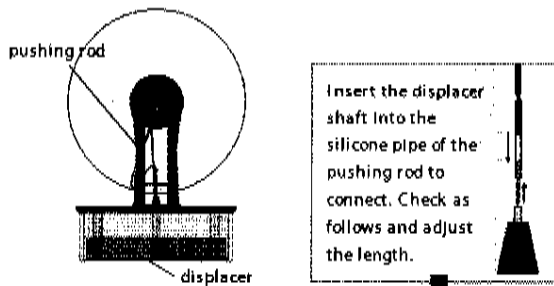
Pay attention to the way to hold the body when tightening the screw D's. The connective angle of the holes in the pulley and in the retainer must be specific. Holding the pulley may change the angle. Be sure to screw as shown in the right picture.

173 Attaching the pushing rod.



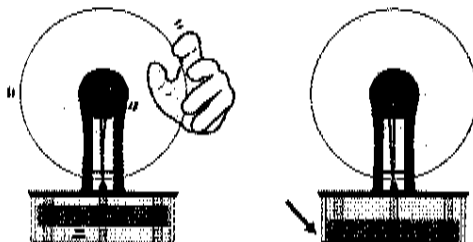
Put a screw C through the hole in the pushing rod and then into the projected hole in the turning disk retainer and tighten. Screw until the whole thread goes in looking from the side. Choose the one of the two holes that comes to the position shown in the figure below.

174 Put the displacer assembled in 171 through the shaft retaining pipe and connect the displacer shaft and the pushing rod with the pipe of the pushing rod.



***Rough and Check!**

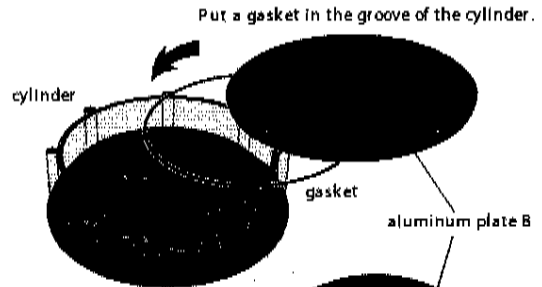
After the displacer is attached, rotate the turning disk by hand. Check if the displacer inclines looking from the side and also if it touches the inside of the cylinder looking from the bottom. In case it touches, see 175 and adjust.



The assembly is proper if the displacer comes very close to the floor at the lowest position.

Finishing

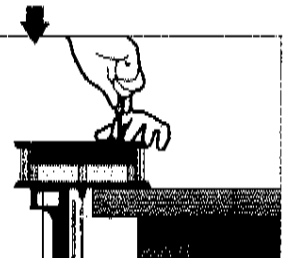
175 Attaching the aluminum plate B to the bottom of the cylinder.



Put the screw holes in the cylinder and in the aluminum plate B together and fasten loosely with screw B's in the same way as 171 ~ 174. After screwing at two points, check if the gasket is off the place or not looking from the side.

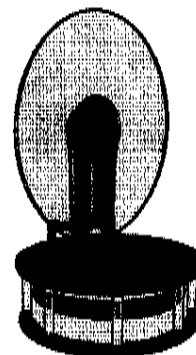
***It is difficult to screw.**

If you turn over the base to screw, the post and the turning table will get in the way. For easy screwing, use a desk or a table as shown in the right figure.



After screwing all the screws loosely, tighten them and make sure that no space is left between the cylinder and the aluminum plate in the same way as 175.

Finished Stirling Engine

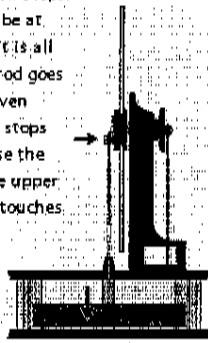


Now the Stirling engine is complete! Before trying the engine, let's check each part to make sure that the assembly goes well.

Operation Check and Adjustment

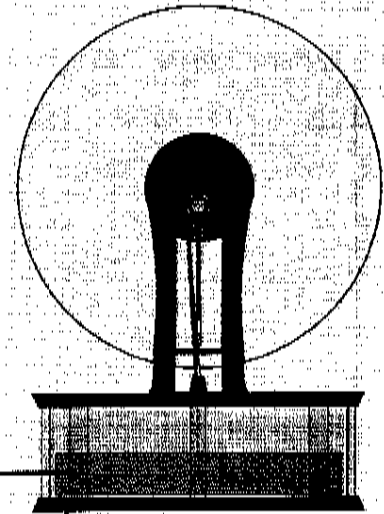
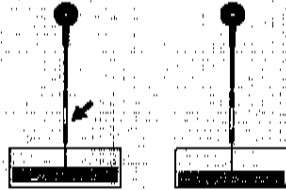
Rotate the turning disk by hand and check if the engine is ready to work. In case it isn't, make an adjustment.

When the turning disk stops, the displacer should be at the lowest position. If it is all right if the pushing rod goes down with a shake even though the displacer stops in the middle. In case the displacer stops at the upper position, it probably touches inside of the cylinder or the aluminum plates. Remove the aluminum plate B and check.



How to adjust

The silicone pipe of the pushing rod may go too high. In such a case, pull down the pipe a little.



The leak of the air is fatal to this engine. Again, make sure all the screws around the aluminum plates are tightened completely.

Though the distance between the pulley and the turning disk is preset, adjusting the distance might help the engine work better according to the assembling condition. In case you want to extend, pull the pulley carefully. In case you want to narrow, put the adjuster in as shown in the figure and push.

How to adjust

adjuster



Put the adjuster in and press.



Check if the head of the screw D touches the pushing rod. In case it touches, the screw is too loose. Tighten it until it doesn't touch the pushing rod.

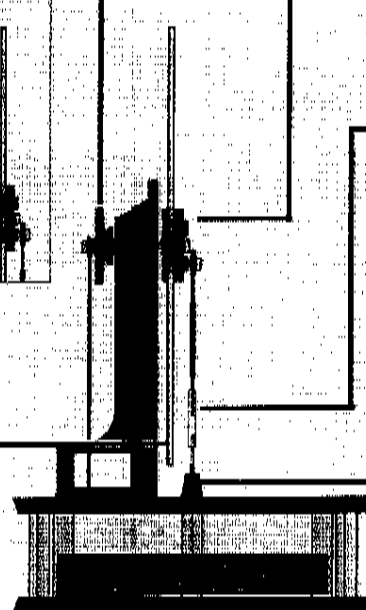
See [diagram] and check the position of the screws at the pushing rod and at the link rod again. In case the angle is not right, turn the pulley softly to adjust.

Check if the silicone pipe of the pushing rod is bent as shown in the right figure. If it is bent, straighten softly with your finger.



Check if the turning disk touches the post. Loosen the screw D's at the turning disk retainer and turn only the disk and find the place where the disk doesn't touch the post. Or else, loosening or tightening two screw D's may help to avoid touching.

There might be friction between the shaft retaining pipe and the displacer. Turn the shaft catch rubber to find the best position of the pipe to avoid friction.

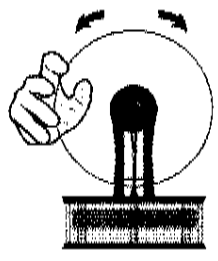


Let's run the engine

Let's try to run the adjusted Stirling engine by the temperature differences produced by four different temperatures of hot water, ice, heat of the hand and air. If the engine is well adjusted, it will run by the temperature difference larger than 20C.

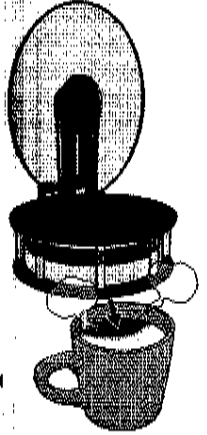
upper side : hot
upper side : cold

lower side : cold
lower side : hot

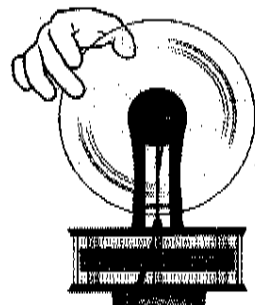


The engine cannot start by itself and need to be started by hand. The turning direction of the engine depends upon the position of the temperatures. Remember this direction to turn. Make sure the screws are correctly attached, or the direction may become reverse.

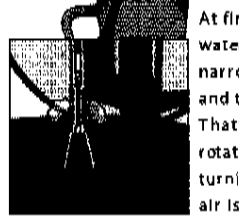
Prepare hot water in a mug cup and put the Stirling engine on top of the cup. Wait for a while until the heat is conducted.



Use plenty of hot water. Be careful of the hot water!



After a few minutes, rotate the disk lightly. The disk will continue to turn if the engine works. If it doesn't work, try to rotate by hand several times and it will begin turning.

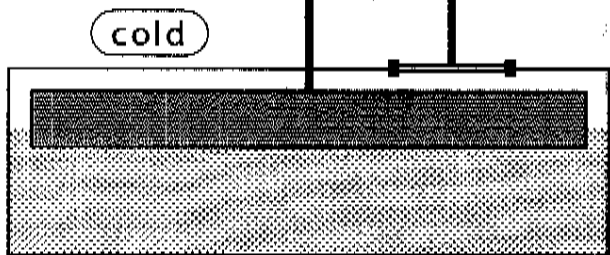


At first, air expands too much by hot water and needs to escape from the narrow gap between the displacer shaft and the pipe until it become neutral. That's why the engine needs to be rotated by hand for a while. Similarly, turning the engine by hand to take in air is necessary when cooling the air.

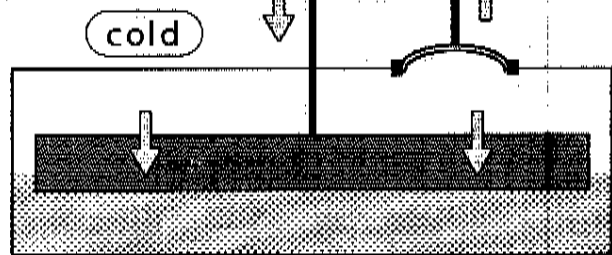
How does the Stirling Engine Work?

How does this Stirling engine work? Let's read the explanation below while rotating the turning disk by your hand. Now, the case when the lower part is hot and the upper part is cold is explained.

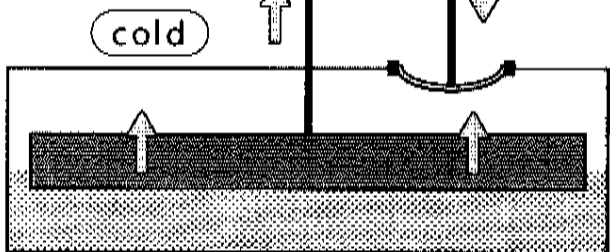
The air below the displacer is heated and expands.



The diaphragm is pushed by the expanded air and the displacer begins to go down.



The diaphragm is pulled down by the contraction of the air and the displacer begins to go up.



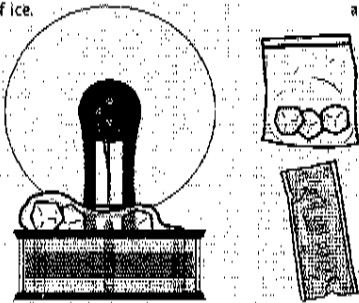
The air goes upper side and gets cold to contract.



If the engine doesn't work, see "Operation Check and Adjustment" and adjust again.

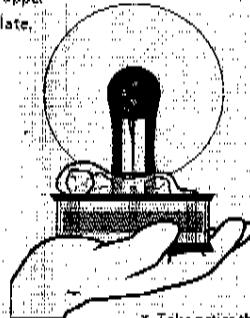
*Run on ice

Use the temperature difference between ice and air temperature to run the engine. Since the temperature of ice fresh from a freezer is about -10C, the air temperature will usually be high enough to run the engine. You can put ice directly on the aluminum plate or zip lock bag will be handy to handle ice. You can use cold gel packs instead of ice.



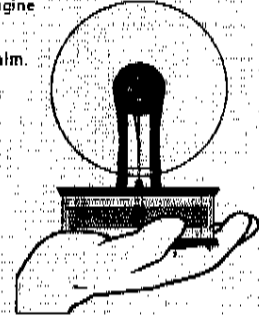
*Use your hand to make the temperature difference

Put ice on the aluminum plate and put the engine on your hand to make the temperature difference between ice and body. When running the engine on your hand, it is important to touch as tight as possible. Pressing down against the hand with the other hand is effective. In that case, be careful not to touch the upper aluminum plate.



*Use the temperature difference between the heat of your hand and the air temperature

Use the temperature difference between the heat of your hand and the air temperature to run the engine. It may take time before the heat of your hand is conducted according to the air temperature. Try to press your hand against the aluminum plate tightly in like manner as the left case. Try not to slant the engine and not to move the palm.

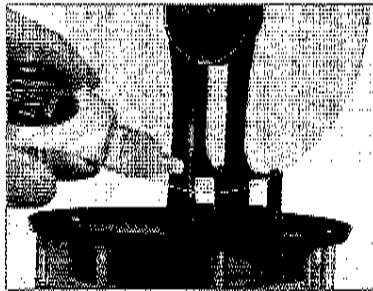


* Take notice that sticking adhesive tape on the aluminum plate may ruin the paint.

How to improve its performance

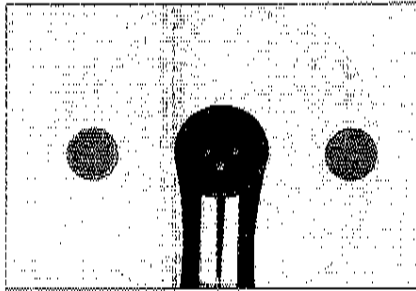
Let's use some devices for good performance. These devices will make the motion smoother.

*oil



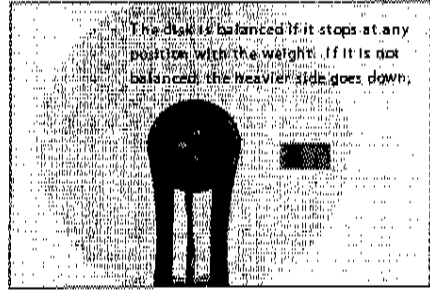
Applying valve oil which is purchasable at instrument shop to the displacer shaft can decrease friction between metals. Do not use ordinary oil since it makes the motion worse.

*Put weights



Put weights on symmetrical outermost two points of the turning disk with both side adhesive tapes. The rotation will steady by flywheel effect.

*Put a balancer



When the displacer comes to the lowest point, put a weight such as an aluminum sticker at the top of the turning disk to balance. Change the place of the weight from the center to the outside to find the best point.