New Prop Rod Design

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Backgtound:

The ovens used by our cooperators in Nicaragua include a fairly heavy lid or cover, hinged to the back of the cooker, that serves two functions: 1) protect the oven when not in user and 2) reflect more light into the cooking area of the oven. The lid is wood framed, sovered with a sheet metal top and a provided with a reflective underside. The present design uses a piece of wood that is 1.5" wide, 1" thick and 3' long to support the lid when the cooker is in use. This piece of wood is connected to the wooden frame of the lid through a single nail, asound which it ppivots. The bottom end of the support (prop rod) is drilled with a set of holes that allow positioning of the lid at different angles. Some ovens have two rods for holding the lid in place. The present prop rod is awkward to use. A new prop rod design that allows easier positioning of the lid and stable support of the lid is desirable.

Design

The design of the solar oven often requires that a reflective lid be placed on it so that the oven can catch more sunlight. It must be able to resist
windy conditions, be easy to construct and use materials that can be obtained in Nicaragua. This design is comprised of a pair of hinges, two wooden rods or bars, a pair of steel rods and some additional hardware. It uses basic wood and standard sized steel rods. The rest can be varied as supply demands: the hinges can be whatever size the user can get and the eye holes can similarly be
varied.
(You don't describe the design or refer to the pictures in the report to make clear what you are writing about. An adequate description is needed before describing construction and should include a description of the materials you are using and the purpose each ot the materials or parts serves.)

Construction

Construction should begin with the placement of the hinges and length of the wooden rods. The desired tilt angles are dictated by where the hinge rests and how long the arms are. The biggest angle is when the prop rods are vertical, or nearly vertical. From there, sequential steps should be taken until the angle is as low as the user desires. There is no set rule for hinge placement, or wood length; the user should decide based on what they want. **Appendix A** has a method of determining placement of catches after the initial length and placement has been decided.
After the initial measures are chosen, the wood should be prepared. If the wood is not ordered in the length desired, cut the two pieces at the same time to insure equal lengths. From there, holes should be drilled for the cross bars. One or two holes should be drilled, depending on how many cross bars the user needs. The design uses ¼ inch threaded steel rods, so the drill bit should be slightly larger. Naturally, the rods should be long enough to span whatever the width of the specific cooker is, with extra length on both ends for screwing on nuts. For drilling the holes, drill a hole in one of the wood arms, then align that arm with the second arm and mark the matching hole point before drilling the second hole. For hole placement, the holes should be near either end of the arms, but not so near the ends that they interfere with any screw from hinges or parts of the cooker that the arms will straddle.
After the holes for the cross bars are drilled, drill pilot holes for where the hinge will attach to the arms. Drill pilot holes for the hinge in the lid as well. The calculations for determining catch placement treat the rotation point of the hinge as the "point" where the rods meet the lid, so align the hinge accordingly. The placement of the wood on the hinge depends on the desired angle of swing of the lid.

: The wood can affect the movement of the hinge, so which side of the wood the hinge is attached to matters. As the picture to the right demonstrates, the wood stops the hinge from swinging above a certain point. In this example, the lost swing angles are undesirably small, so no loss of function is experienced. Which angles are lost depends on the position of the hinge and length of wood, so other projects will have to physically compare designs.

The next step is to attach the catches. The catches in this design are eye hole screws (fig. 1). After determining their placement, check to make sure the chosen location will not interfere with other parts of the cooker (i.e. panel screws). Drill pilot holes and screw in the eyelets. After attaching the eyelets, put a nail or a screw into the bottom of the wooden arms. The nail/screw should be just small enough to fit through the eyelet. Then attach the wood arms to the hinges and then the hinges to the lid. The hinges should be connected to the lid using bolts, washers and nuts.
The final step is installing the cross bar. This proved to be very difficult. The only way to ensure that the distance between the arms is maintained is to install the rest of the contraption and prop the lid up with the arms. Once the arms are in place, screw the steel rod from one arm to the other, bridging the gap. This is very slow and tedious, but it ensures that the distance is correct and as long as the holes were drilled well the rod should meet the hole on the other side. This process takes forever, but can be expedited by using a hand drill on the cross bar. The cross bar is held in place with nuts and washers on both sides of the wood, so make sure these are in place before finishing reaching the other side.

Closing

The current design is fairly easy to build and the materials are redily available. No testing has been done to see how this design and possible variations hold up against wind loads. The nails in the eyelets and the fact that both rods must be moved simultaneously make accidental removal by wind movement unlikely. The bolts holding the prop rod in place have a tendency to move. The shop model used a special nut that bites into the wood, but such a part may not be available everywhere.

Pictures

Figure 1
Figure 2
Figure 3

Appendix A:

The method of calculating eyelet placement depends on the first eyelet being the biggest angle and the angle when the prop rods are vertical to the cooker. Subsequent distances are calculated using the law of cosines.

X: the largest desired angle.
x: the length of the prop rods.
y: the distance along the lid of the hinge placement
z: the distance from the cooker end where the first eyelet goes. Calculated using Pythagorean

Theorem.
x and y are the same distances as above: the lengths the user has chosen.
X1: the desired angle of the next prop point.
z1: the distance the eyelet needs to be from the end to achieve angle X1.
Law of Cosines:
Formula can be reversed to calculate angle X1 of a desired distance z1.