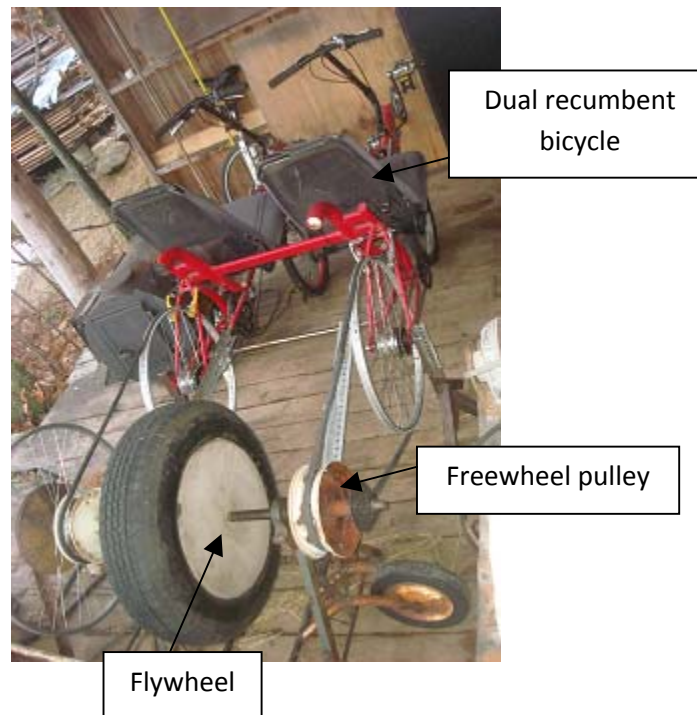




# Dual-Recumbent Power Station

## Introduction

Bicycle technology has helped people's speed and travel capabilities without burning fossil fuels. By turning this efficient use of legs into belt-driven power, D Acres is decreasing its reliance on electricity. For the design below, a two-person recumbent bicycle is altered and attached to a custom power station incorporating a flywheel and two freewheels to power belt-driven equipment.



## Design

The purpose of the dual-recumbent bicycle power station is to provide a more efficient pedal-powered device as compared to a single person bicycle unit. The two pulleys, connected to the rear bicycle wheels, use freewheel technology to reduce the resistance experienced by the power station. This decrease in resistance allows the power station to run with more efficiency. The flywheel also increases the operators' abilities to pedal smoothly.

The dual-recumbent bicycle was a custom build completed offsite. The power station can also be operated with the combination of any two bicycles. The recumbent, however, provides a more comfortable pedaling position than typical upright bicycles. An upright bicycle is designed to help the rider reduce wind resistance. Since the bicycle will be stationary, the wind resistance factor is unnecessary and only makes the user more uncomfortable over an extended period of time.

**Tools needed:**

- Welder
- Metal cutter (Acetylene torch was used for this build)

## Flywheel

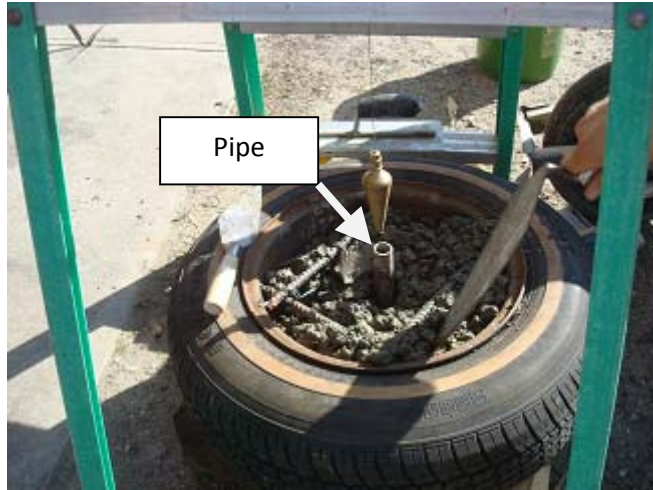
**Parts needed:**

- Car rim and tire
- Rebar
- Cement

A flywheel is important because pedaling a bicycle is not 100% efficient in application of power. At the point where one pedal is at the bottom of its rotation and the other is at its top, the legs are not providing any power to the system. This is also the point when operating a bicycle-powered device can become very choppy and uncomfortable. The flywheel stores the necessary energy to get the operator through this rough patch without disrupting the smoothness of the experience.

The flywheel was built using a truck rim and tire. Rebar was welded on the inside of the rim to support cement that would fill the interior. A barbell weight was welded to the center of the rim to provide a snug fit for the axle. A pipe was placed through the center of the rim before pouring the cement so that the flywheel could be mounted onto the axle of the machine after the cement had dried. The pipe was moved at hourly intervals to keep it from binding to the cement. A level and plumb bob were used to make sure the tire was level and the axle was center.



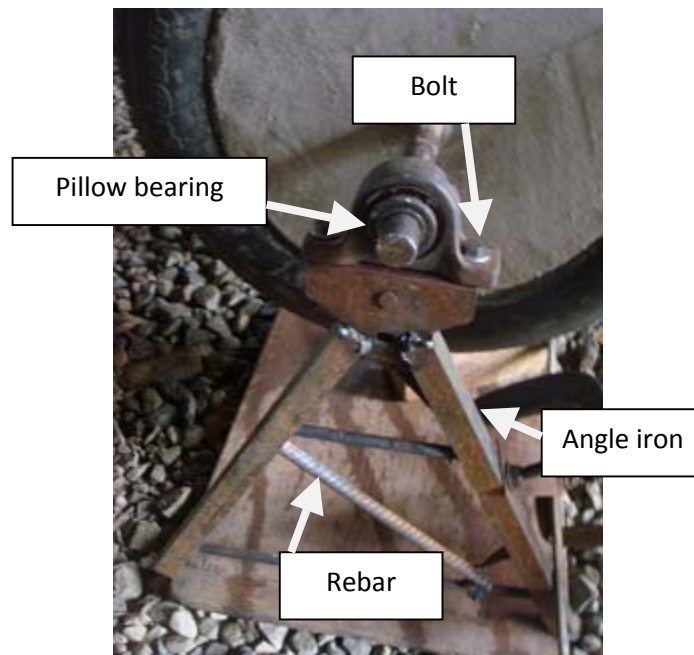


## Frame

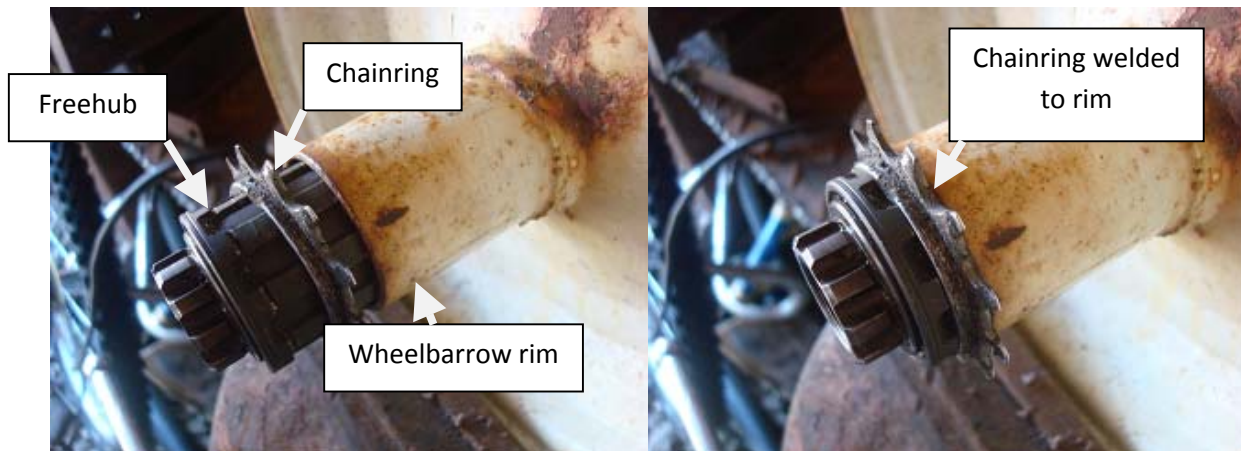
### Parts needed:

- (2) Pillow bearings
- Axle
- Angle iron
- Rebar

The frame holding the flywheel and pulleys incorporated triangles in its design to support the weight of the power station. Angle iron and rebar were used to create the frame. The pillow bearings are mounted atop the frame on a flat piece of welded metal with two holes. This allows the bearings to be removed with a wrench if necessary.



The pulleys driving the flywheel are wheelbarrow rims. To make them freewheels (spin freely when not driving the flywheel) a freehub was removed from an existing freewheel bicycle wheel and placed inside the wheelbarrow rim. A freewheel is important because it allows the flywheel and pulleys to continue running without the interference of friction from the driving pulleys. A freewheel bicycle wheel is found on almost any non-fixed gear bicycle. A chainring from the rear gear set was welded to the rim so that the freehub could slide in and out of the wheelbarrow rim without being permanently fixed to it.



A major consideration in the dual-recumbent bicycle power station was the bicycle's fixed width between wheels. The pulleys had to mirror this distance on the power station. The available axle was not long enough and extensions had to be welded onto the ends.

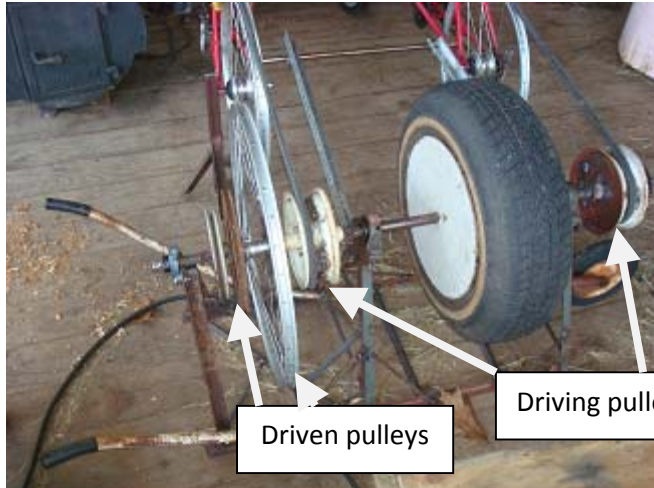




Extended axle



Enough space was left on one end of the power station axle to mount pulleys. These pulleys are different diameters to allow for different rotation speeds depending on what is required by the device being operated. A wheel and two handles were also welded to the power station frame to make transportation of the system easier.



Driven pulleys

Driving pulleys

The extended axle is not strong enough to manage forces put on it by the belt. To keep the axle from bending a floating bracket was built out of angle iron and a bush bearing. It is floating because the bolts securing the bracket at the base are loosely tightened and allow the bracket to move with the system while keeping the extended axle within its elastic limits. The axle can bend slightly and will return to its original position when the forces are relieved as long as the bracket is engaged. The bracket can be removed to replace the belts by unscrewing the two bolts at the base.



## Bike Mount

### Parts needed:

- Angle iron

The dual-recumbent bicycle is mounted on two custom angle iron stands. A stand is located on the outside of each of the rear wheels. The stands keep the back wheels off of the ground and are strong enough to support the weight of two operators. Each stand has a hole that fits over the axle of the back wheel. This allows the stand to be mounted without any additional materials.



## Tension

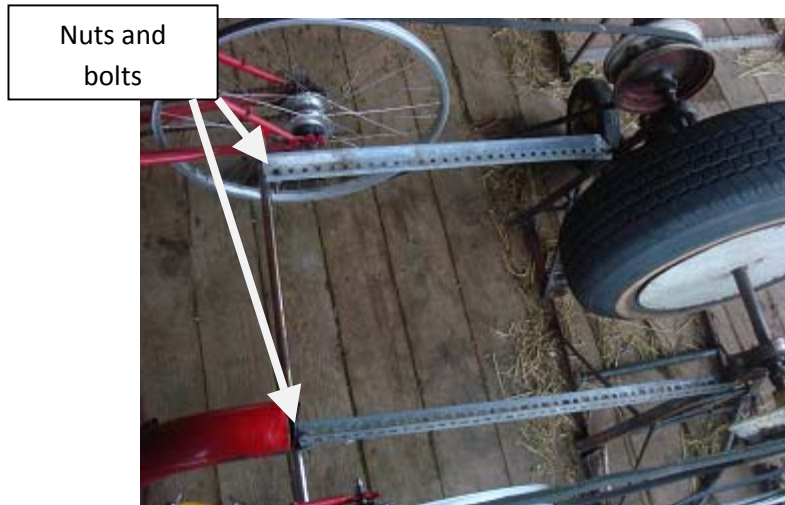
### Parts needed:

- (2) V-belts
- (4) Nuts and bolts
- (2) Perforated metal

To keep tension in the system two pieces of perforated metal. Without tension the belts will slip on the pulleys. The nuts and bolts are placed in the metal to create a brace against the bicycle. The other end of the metal is placed in notches on the frame. The notches are made of nails that were welded to the frame. This design keeps the tensioning system within the machine and minimizes the system's footprint.



Notches



Nuts and bolts

## Pulley Ratios

The pulley ratio has a large effect on the rotational speed output of the system. A small pulley driving a large pulley will produce a low rotational speed in comparison to the driving pulley. A large pulley driving a small pulley will produce a high speed. This can also be thought of in terms of horizontal distance. A pulley that has a circumference twice as large as the pulley it is driving means that for every rotation of the driving pulley, the driven pulley rotates twice.

## **Application**

The power station can be used for a number of devices. It can drive a belt sander, a washing machine, a blender, etc. With the different pulley sizes, the power station is able to be utilized for power or for speed or for both. Either one or two people can pedal. Devices that require a lot of power, however, will need two people pedaling; otherwise, slippage will most likely occur in the belt.