

# SPC Construction Plan

## Introduction

A South Pointing Chariot is a chariot on which a figure stands whose arm points south no matter which way the chariot is drawn. The official definition is as follows.

*It was said that in the battle between the Yellow Emperor and Ci-you at Zhuolu, Ci-you used magic powers to produce a great fog, which caused the Yellow Emperor's army to lose their way. Because of this, the Yellow Emperor invented the south-pointing chariot to guide his troops, which helped him emerge victorious over Ci-you.*

*The Battle of Zhuolu was an important event in ancient history, a key step that helped the Yellow Emperor to realize his ambition. As to whether or not he invented the south-pointing chariot, there is no evidence he invented it, since archaeologists are yet to provide such evidence. However, "Si-nan" (a type of compass) was invented during the Warring States Period. South-pointing chariots were found in Han and Wei Dynasties and models were made for experiment.*

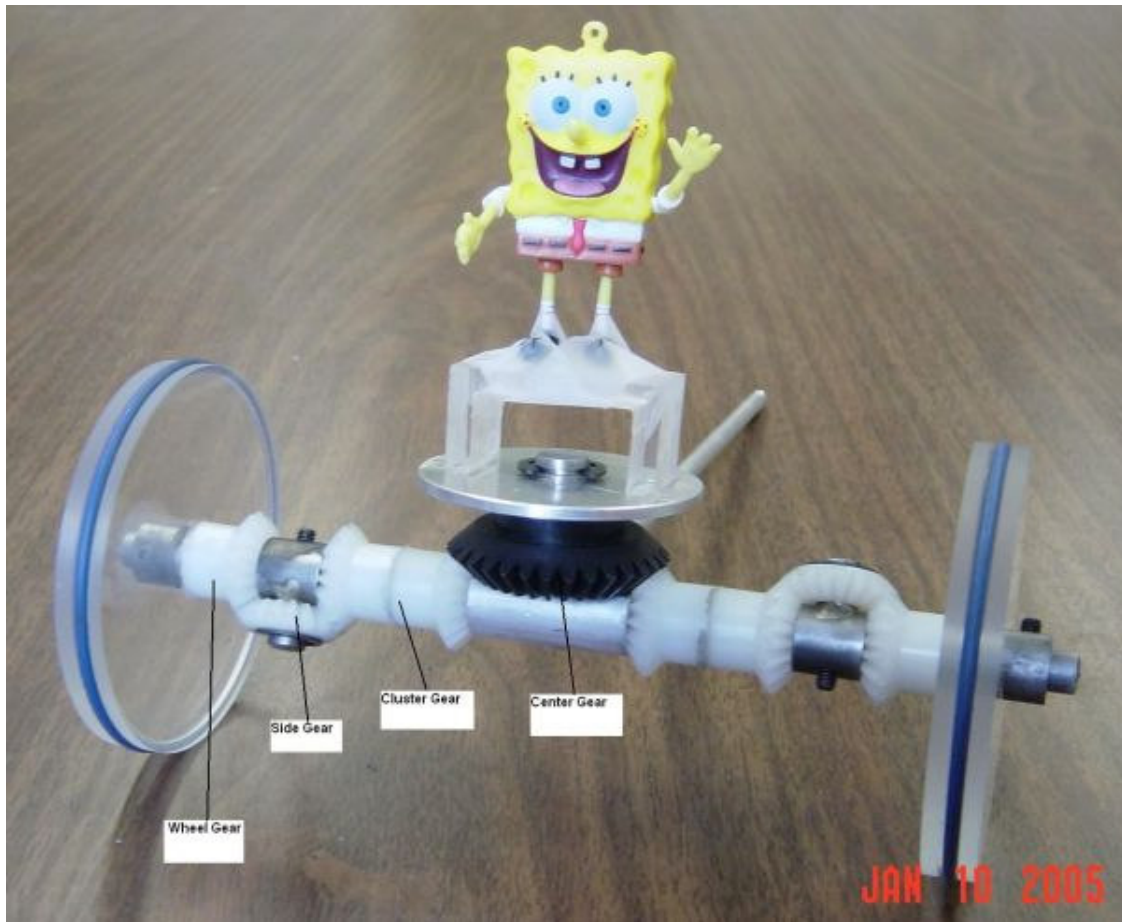
Source: <http://www.china10k.com/english/history/1/11/11c/11c06/11c0616.htm>

South pointing chariots date back as far as 2634BC and new designs are still currently being developed. The direction of south was chosen for the chariots because in Chinese culture south was the favorite direction as north is in our culture. The Nuttall design which has been chosen for this project was developed by Mr. John Nuttall in recent days. Nuttall's design uses 3 differentials encompassed by some basic constraints. These constraints are as follows: (see next page)

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## Basic Relationships



## Ratios

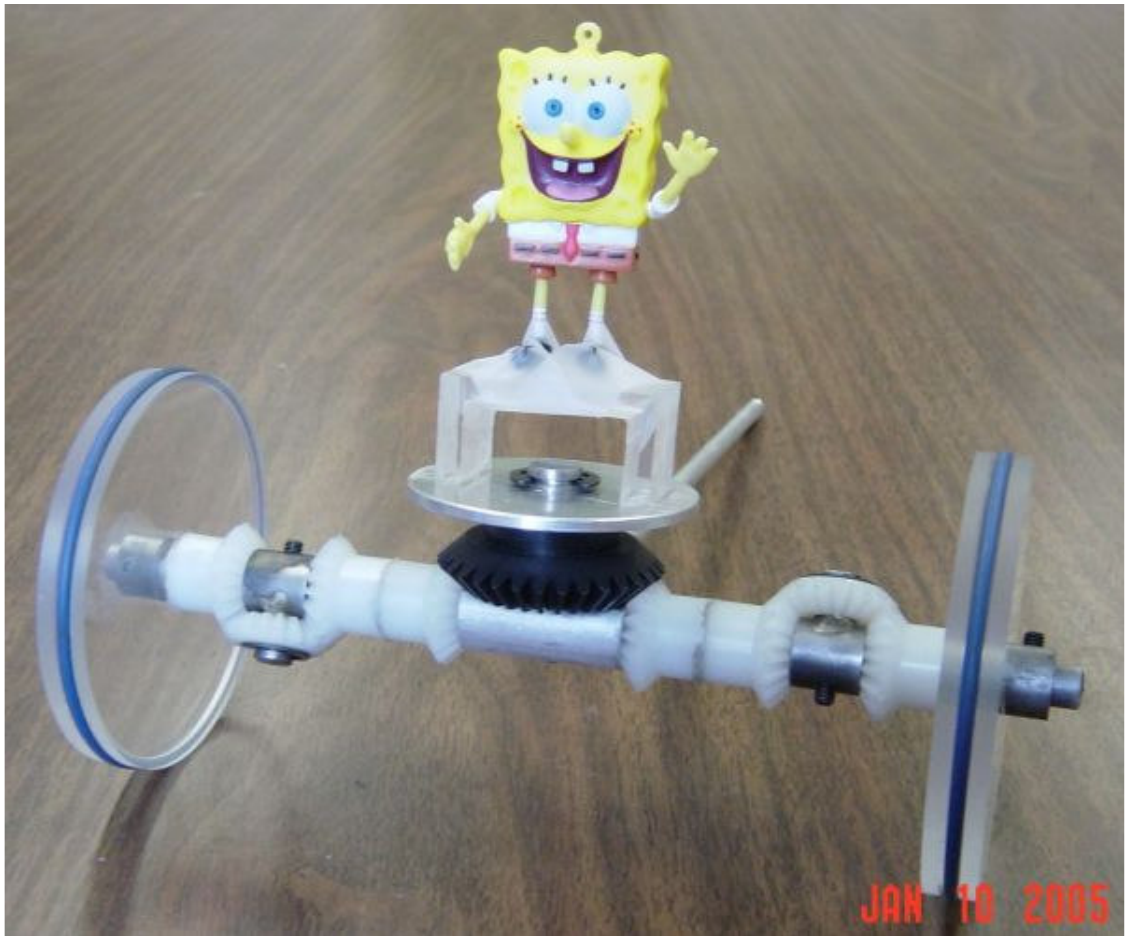
Wheel Gear : Side Gear 1 : 1

Side Gear : Cluster Gear 1 : 1

Cluster Gear : Center Gear 1 : 2

Wheel Diameter =  $\frac{1}{2}$  Wheel Spacing

## South Pointing Chariot Construction



## **Parts Overview**

### **Main Axle**



### **Axle**

For this design a steel axles was chosen.

## Wheels, Wheel Gears and Collars



### **Wheels**

The wheels were constructed from Plexiglas. The wheel's diameter was equal to  $\frac{1}{2}$  the spacing between the wheels. A small notch was placed in the wheel with a lathe and an O-ring was placed inside to supply traction.

### **Wheel Gears**

Wheel Gears are attached to the wheel so that  $\dot{\alpha}_{\text{wheel}} = \dot{\alpha}_{\text{gear}}$ , where  $\dot{\alpha}$  = the angular displacement of the wheel.

### **Collars**

The collars were constructed to hold the wheels in place when the chariot is assembled. They were constructed from round steel bar. Set screws were installed to hold the collars to the shaft.



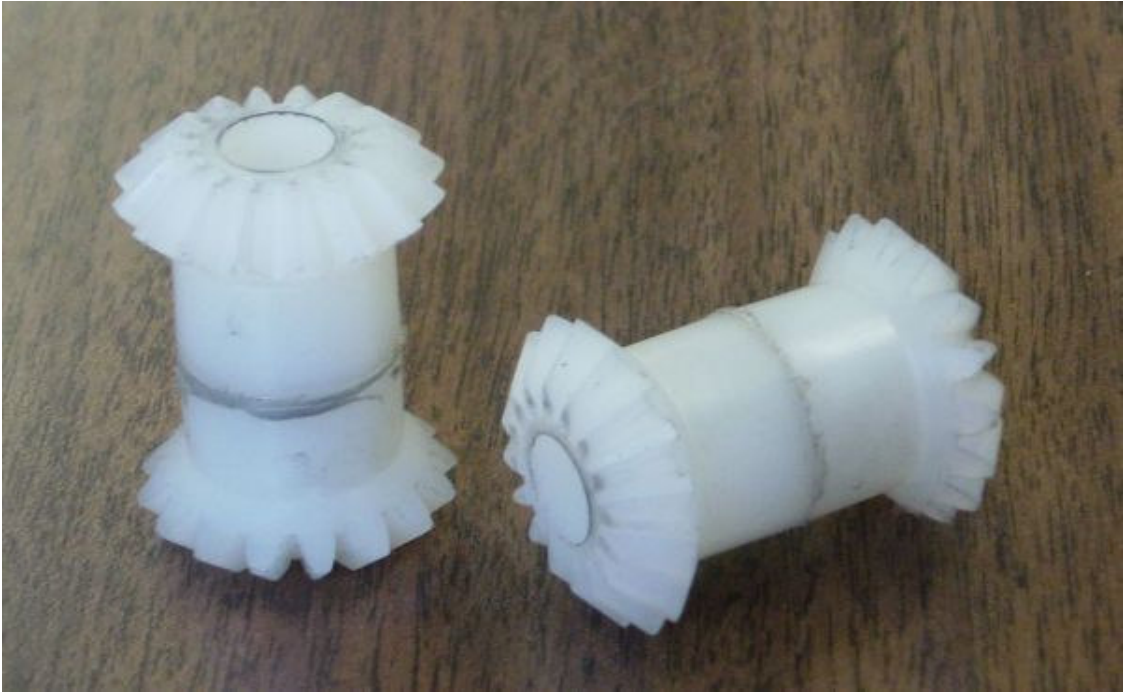
## Side Gears



## **Side Gears**

The Side Gears consist of a collar which holds small shaft. The small shafts are held in by with silver sauter. The gear is placed on the shaft and held in place with an E-clip. The Side Gears are held in place on the shaft by set screws.

## Cluster Gears



## **Cluster Gears**

Cluster Gears are two gears which are held together. They are often pinned and in this case they are glued.

## **Body, Pull Arm and Center Shaft**



### **Body**

The Body was constructed from a piece of round aluminum bar. A hole was drilled through the Body to allow the Main Axle to pass through. (Note: The main axle is intended to rotate freely within the Body) The top of the Body was flattened with a milling machine and a hole was drilled in the top to hold the Center Shaft. Finally a hole was placed in the front of the Body to hold the Pull Arm.

### **Pull Arm**

The Pull Arm was constructed from a piece of round aluminum bar, placed into the hole drilled in the front of the body and welded in place.

### **Center Shaft**

The Center Shaft was constructed from a piece of round steel bar. A hole was placed in the bottom of the shaft to allow the Main Axle to pass through when it is placed into the body. The Center shaft is press fitted into the body. Finally a small notch was placed in the top of the Center Shaft to allow an E-clip to hold on the Center Gear.



### **Center Gear and Top Plate**



### **Center Gear and Top Plate**

The Center Gear and Top plate are also glued together. They are placed on the Center Shaft and held in place by an E-clip. The top plate has been installed to provide a surface for a figurine to stand on.

## Assembly

### Step 1



### Step 2



Place the Body, Pull Arm and Center Shaft on the Main Axle.

**Step 3**



Place the cluster gears on the Main Axle.

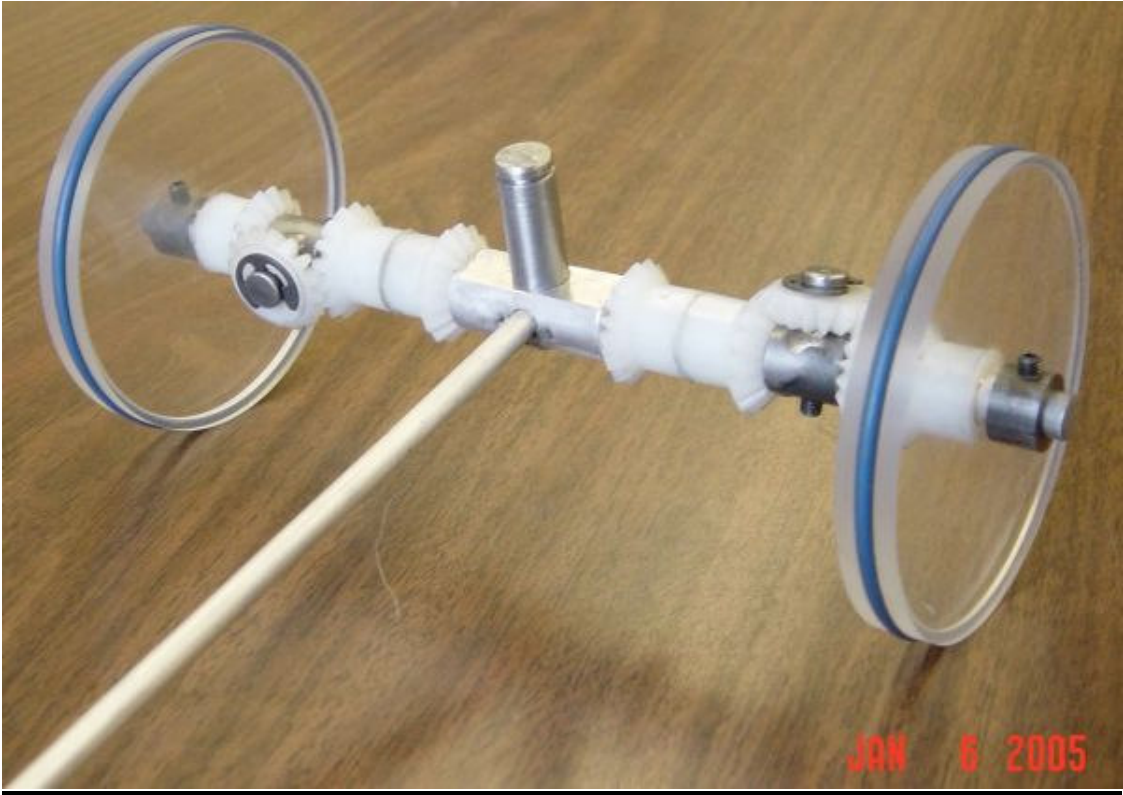
**Step 4**



Place the Side Gears on the Main Axle.



**Step 5**



Place the Wheels and Collars on the Main Axle.

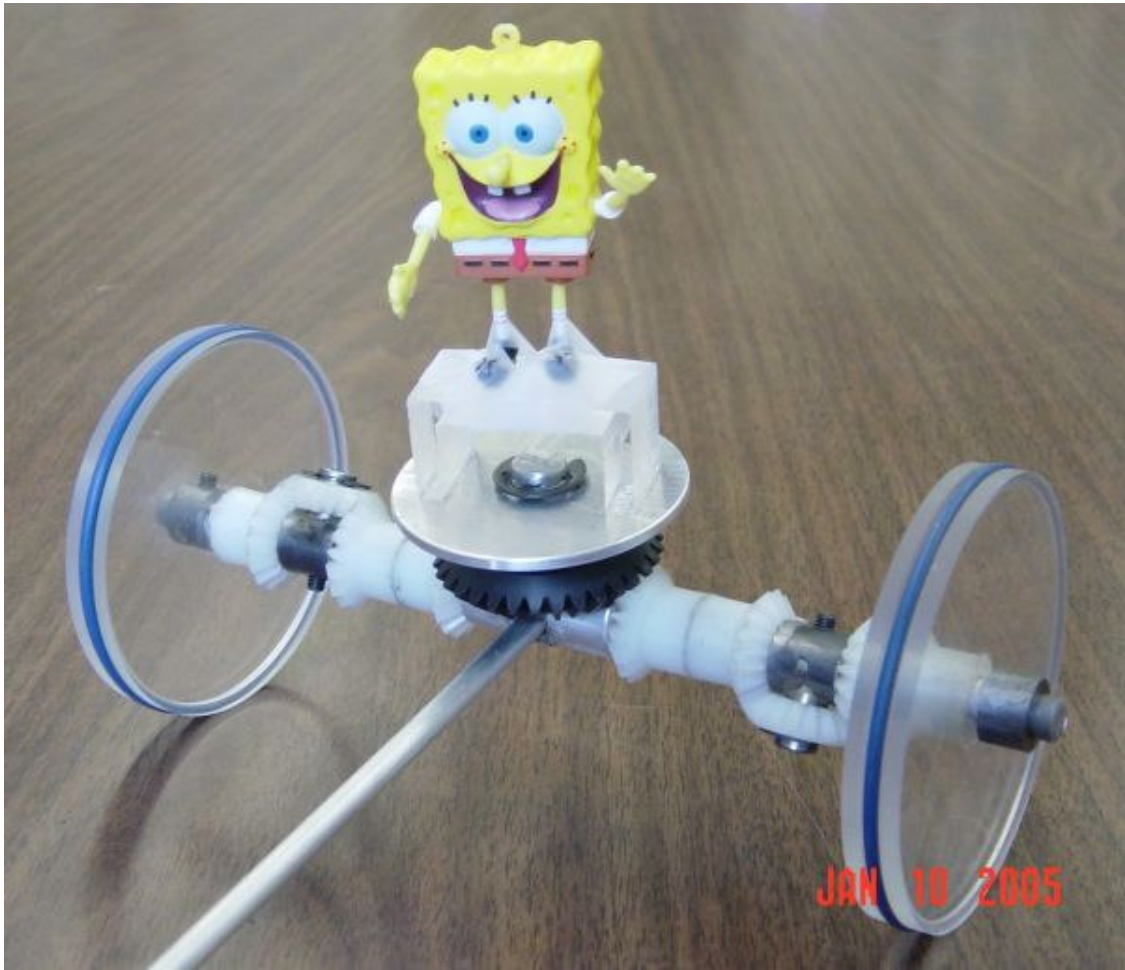
**Step 6**



Place the Center Gear and Top Plate in the Center Shaft.



**Final Step**



Place Figurine on the top of your chariot.