

# “Design and Fabrication of Hand Operated Spring Powered Cycle”

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**Abstract-** A cycle which is operated by hand and stores power in spiral spring and uses it to drive and gives more rest to driver. This cycle is operated by hand so that it can also be used by physically handicap people. This cycle is inspired from rowing cycle and we have modified the mechanism in rowing cycle. We have utilized the spiral spring to store the potential energy and use it whenever required and when spiral spring drives the cycle the driver can take rest. For workout this is best cycle. Rowing motion is better option for workout so, that for sportsperson this cycle is best for workout. We have also used a particular spring for we can get high speed rather than regular and geared cycles. This cycle has highest speed than other cycles. By regular effort we can travel more distance by use of spiral spring. It is more efficient. By use of spiral spring in rowing cycle for replacing constant effort in regular cycle and use the power of spring and gives the rest while driving the cycle. We can drive this cycle in any road condition.

**Index Terms-** Hand operated spring powered cycle, Hand operated cycle, Row cycle, Spring powered cycle, Spiral spring cycle

## I. INTRODUCTION

As the handicapped person uses effort to drive cycle and they feel fatigue. They can't take rest while riding cycle. Travelling distance of handicap cycle is lesser than other cycles. So, we find out solution, we designed a mechanism which can give rest while driving so they can't feel fatigue comparatively to handicap cycle, and at same effort cycle can travel more distance. We have designed a cycle which is operated by hand and stores power in spiral spring and uses it to drive and gives more rest to driver. This cycle is operated by hand in order that it can even be employed by physically handicap individuals. This cycle is galvanized from row cycle and that we have changed the mechanism in row cycle. A row cycle could be a vehicle operated by a row motion of the hand. By the handlebars steering, braking, and shifting area unit causally done. row cycles are unit in numerous styles, notably with relevance frames and drive mechanisms. Commercially, production numbers for row cycles are unit is tiny compared with regular bicycles. row cycles have the potential to be quicker than regular bicycles as a result of the upper output of torsion generated by a row motion.

## II. LITERATURE REVIEW

### A. Row Cycle History

The use of a rowing-like action to propel a land vehicle goes most likely to the decade, as George W. Lee used a sliding-seat during a trike. Road sculler races were command in Madison sq. Garden within the Eighteen Eighties. A toy catalog from FAO Schwarz in 1911 publicized a four-wheel "Row-Cycle" for youngsters, operated exploitation 2 levers during a standing position and with steering done by the feet. within the Nineteen Twenties, Manfred Curry in Germany designed and created the Land small boat ("land boat"), a four-wheel vehicle that might be called a Row mobile within the English-speaking countries. A short subject from 1937 shows a rowed bicycle that's terribly the same as today's Crafts bury SS row bicycle, Row bike.

- Propulsion and steering

Some rowed vehicles use a stroke the same as a boat, in this force is employed only straightening the body, the drive portion of the stroke, not the recovery. different rowed vehicles, largely those who use linkages and crankshafts in their drive trains, use force in each straightening and bending the body. On most, the handlebars move; most even have moving footrests and a few have a moving seat. The handle bars on some rowed vehicles travel on a curved path owing to the handlebars being mounted to a set length lever fastened to the frame. Some decide to simulate a lot of level stroke utilized in row a boat, as an example Street boatman. Street boatman has "the most natural row action of any row vehicle to date". the road boatman uses a steering mechanism motivated by servos and controlled by the rider with a joy stick.



Figure 1: Old row cycle

# • Drive train

Rowed vehicles usually have one amongst 3 drive trains: chain, linkages, or cable. The Row bike complete uses a regular chain, rear gears, and derailleur. The chain doesn't travel during a loop, as is that the case with a regular bicycle. It moves back and forth over the rear cog in a very reciprocatory motion. The chain is connected at one finish to the frame of the row bike and to a bungee rope on the opposite. because the boatman pulls back the chain engages the rear cog and therefore the bungee rope is extended, and once the boatman returns forward the bungee rope contracts, propulsions the chain back and making certain there's no slack within the chain. All Row bikes have a rear derailleur, even single speeds, because of the requirement to stay correct tension within the chain. Row bikes that use linkages embrace Champion and Power pumper. They use linkages connected to a crank shaft, the same as a pedal automobile. The row bike and Street boatman use a cable that coils and uncoils a few spool. This calls his version a sneak drive.

## B. Patent Analysis

### 1) Spring powered bicycle: -

Author: - Mario Filippo Alvigini, 217 W. 18th St., New York, N.Y. 10011

Publication Date: - Aug. 22, 1978

Analyzed description: -

In this paper there is a mechanism which uses spiral spring's energy to drive the cycle. A spiral spring is connected to a drum and drum is clutched to back wheel. There is a foot pedals mounted each on a cylindrical oscillating shaft on opposite sides of a drive wheel gear. By oscillating them spring is wind up and by unwinding drum clutched to back wheel which can drive cycle.

### 2) Human powered drive-mechanism with versatile driving modes: -

Author: - Antti M. Keskitalo, 4014 Norwood Dr., Columbus, Ga. 31907

Publication Date: - Nov. 25, 1997

Analyzed description: -

From this research paper, we get steering mechanism in which steering wheel is connected to pulley with the help of sleeved cable which is connected to opposite sided of slot.

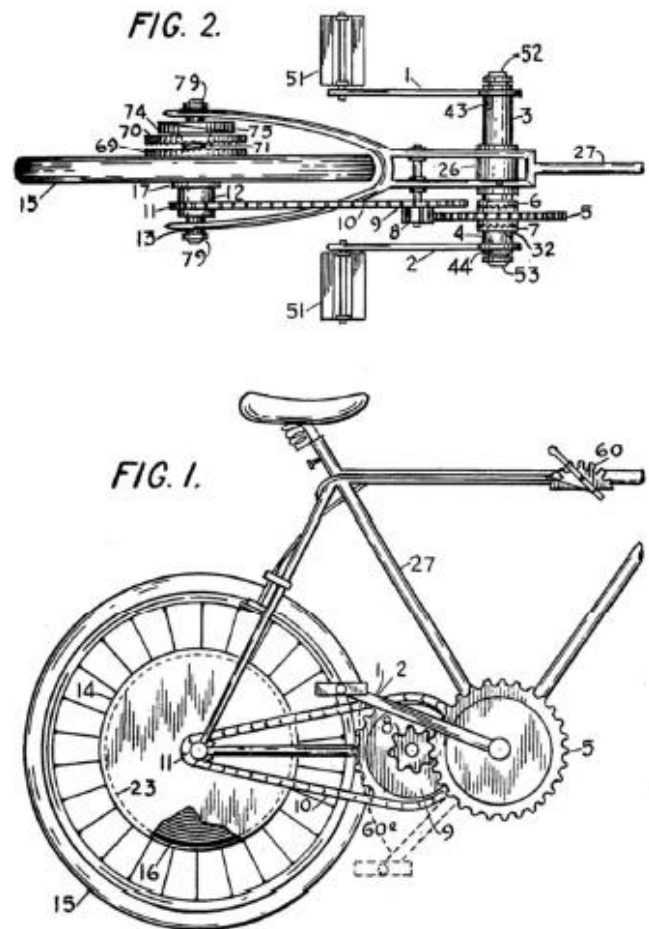


Figure 2: Spring powered bicycle

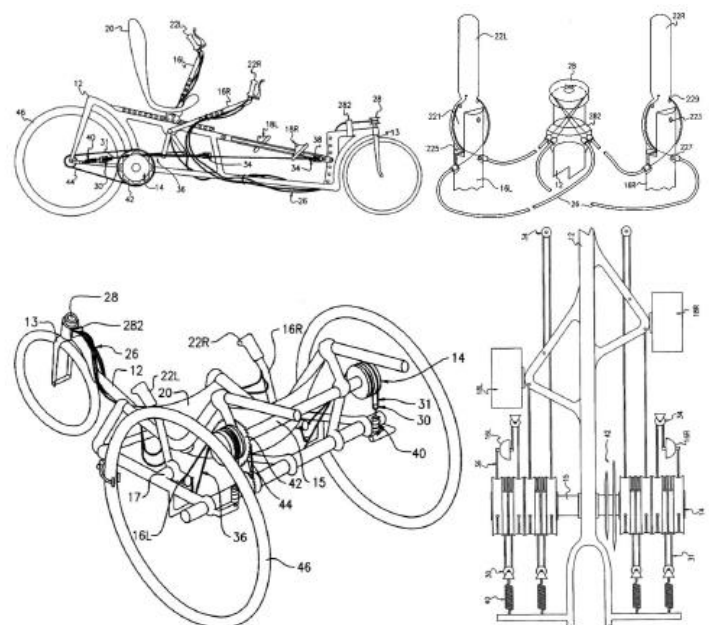
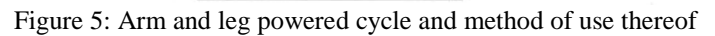


Figure 3: Human powered drive-mechanism with versatile driving modes

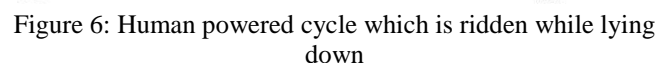
Publication Date: - Mar. 20, 2001



Publication Date: - Aug. 5, 1997



Publication Date: - Aug. 26, 2003



In this paper, the cycle having a steering device connected to the front wheel forks and formed by handlebars between which the rail extends. The foot actuating devices are formed by a foot rest



for both feet. The Seat can be displaced on the rail in a longitudinal direction of the rail.

### C. Literature Review – Conclusions

- 1) Spiral spring energy is used to drive the cycle and can take rest while driving due unwinding spring.
- 2) New steering mechanism founded in which sleeved cable is used to steer cycle.
- 3) Comfortable seating and better frame design and environmental safety factors.
- 4) The chain mechanism using alternate arm or leg or both powering systems to cycle.
- 5) There is a frame in which driving the cycle while lying down to get comfortable seating and foot rest.

### III. SELECTION OF MATERIAL

For cycle, selection of material for all components is necessary. So that we have selected the materials for components of cycle which given as below:

Frame material should be light in weight so that aluminum frame is used.



Figure 7: Aluminum frame

Sprocket & chain material is stainless steel as per ASME/ANSI standard



Figure 8: Chain & Sprocket

Gear & clutch is also as per ASME/ANSI standard steel. Steel is commonly most fascinating as a result of it offers a winning combination of high strength-to-weight quantitative relation, high resistance to wear, the flexibility to boost the physical properties through heat treatment, and competitive evaluation.



Figure 9: Gear & Clutch

Here, spiral spring material is SAE 304 SS as selected.



Figure 10: Spiral spring

Shaft material is mild steel.



Figure 11: Shaft

### IV. MODEL

As the handicapped person uses effort to drive cycle and they feel fatigue. They can't take rest while riding cycle. Travelling distance of handicap cycle is lesser than other cycles. So we find out solution, we designed a mechanism which can give rest while driving so they can't feel fatigue comparatively to handicap cycle. And at same effort cycle can travel more distance. By our imagination we have drawn a rough model on a drawing sheet. Basic idea is to combine rowing cycle to the spring power of spiral spring

#### A. Product Architecture

We have combined rowing cycle to the spring power of spiral spring and added sleeve cable steering system. For mounting spring in cycle we have to design a mechanism which can run cycle with spring energy.

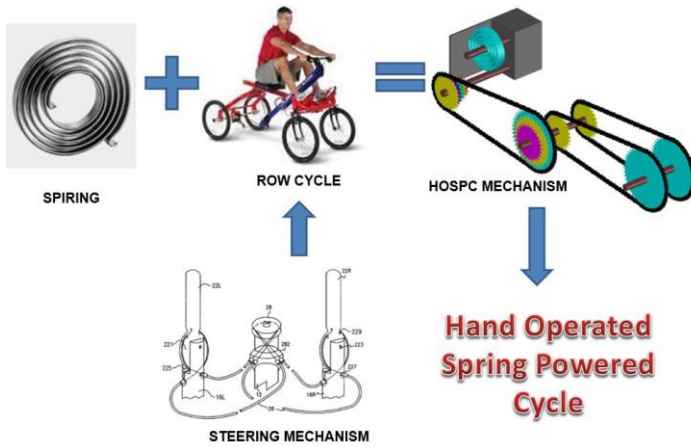


Figure 12: Product Architecture

### B. Cad Model

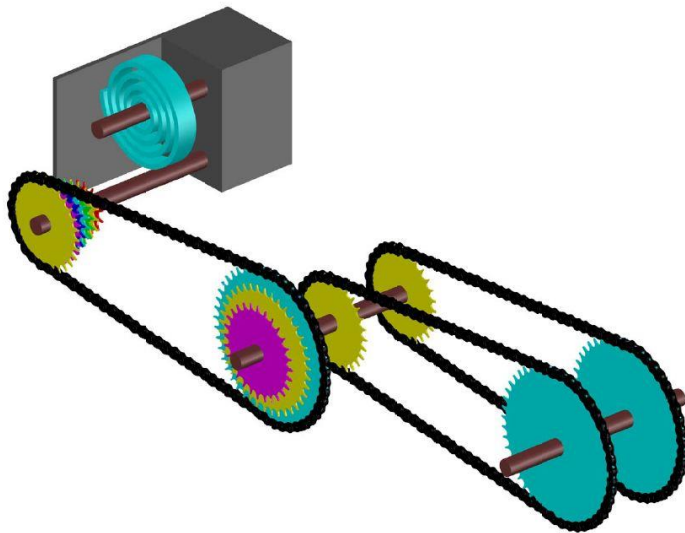


Figure 13: CAD model of mechanism

We have designed this cad model in CAD. We have to put all the dimensions to create mechanism and other parts. It is very difficult to design such mechanism in CAD.

### V. DESIGN

We have designed a mechanism to use spiral spring energy to drive cycle and done calculation about designing spiral spring, and assumed unavailable data. We have found out torque based on chain & sprocket rotation and by Newton's second law of motion. First of all, the rowing cycle design is as follows. In simple rowing operation there is two chain drive system as shown below picture. One chain drive rotates and other will rest in forward rowing and vice versa in backward.



Figure 14: Rowing mechanism



Figure 15: Row cycle  
(Bungee cord mechanism for rowing)

The below picture shows rowing cycle model. It has aluminum frame. By use of aluminum frame this cycle has low weight.



Figure 16: CAD model of frame structure

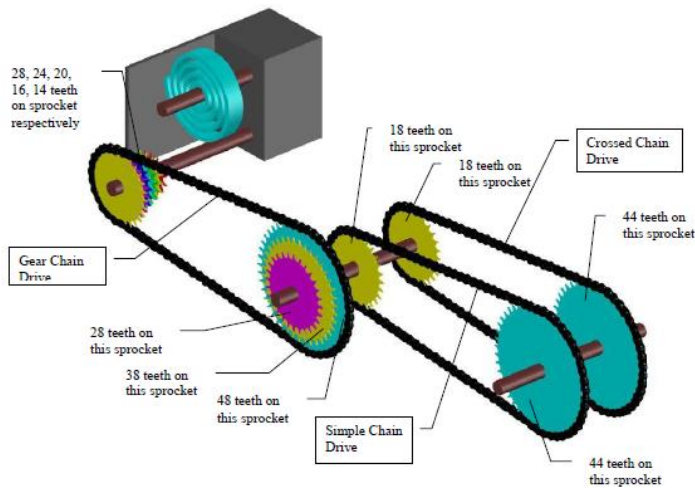


Figure 17: CAD model of mechanism with details

First of all, by rowing motion to the driving shaft one chain drive rotate and other will rest in forward rowing and vice versa in backward and there is a clockwise ratchet system on one chain drive and other has anti clockwise ratchet system. The driving shaft rotates idler shaft. In idler shaft there is geared chain drive which rotate driven shaft. The driven shaft is connected to gear box which is connected to auxiliary shaft having spiral spring mounted. Spiral spring is wound by gear box and when its wound gear box will change gear and engaged to driven shaft which has wheels mounted and drives wheels. In steering mechanism there is wire system to pull one side and steer the front wheel.

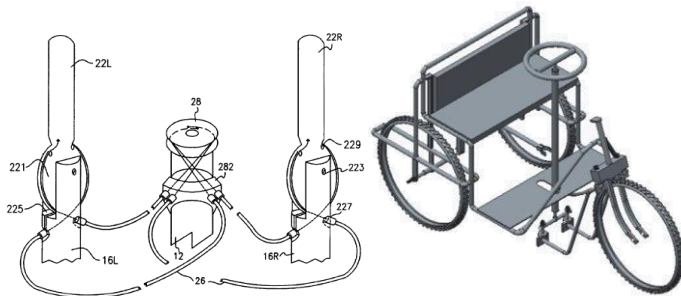


Figure 18: Steering mechanism

## VI. CALCULATION

### Some Assumption in Components

As per ideal condition

The sprocket teeth calculated and as per 60' rotation twice of handle the total rotation of each sprocket is calculated.

Assuming 10 rowing operations in 1 minute

Now power by human force is calculated as per reference of website

<https://www.ccohs.ca/oshanswers/ergonomics/push1.html>

The human hand pushing and pulling power is 100 W(watt)

Assuming weight of cycle is 100 kg and shaft radius 0.015 m and for 40 km./hr. acceleration  $a = 11.11 \text{ m/s}^2$  (because  $1 \text{ km/hr} = 0.278 \text{ m/s}^2$ )

Gear ratio is 1 : 1 having 200 mm diameter

### A. Calculation of Sprocket & Chain

The sprocket teeth calculated and as per 60' rotation twice of handle the total rotation of each sprocket is calculated.

It is calculated as per, rev. on last sprocket =  $\frac{t1}{t2}$

Where t is teeth on sprocket

Then ratio as per,  $\frac{(\text{rev. on last sprocket} \times 120')}{360'}$

rev. on sprocket 2 is 0.8 by ratio,  
 $\frac{(\text{rev. on last sprocket} \times 120')}{360'}$

Assuming 10 rowing operations in 1 minute

So,  $10 \times \text{rev. on last sprocket}$

RPM of last shaft =  $10 \times 2.74$

RPM of last shaft = 27.4 RPM

### B. Maximum Power Generated

Now power by human force is calculated as per reference of website

<https://www.ccohs.ca/oshanswers/ergonomics/push1.html>

The human hand pushing and pulling Power is 100 W(watt)

The power on last shaft is calculated as below

$$\frac{p2}{p1} = \frac{t1}{t2}$$

$$p2 = p1 \times \left( \frac{t1}{t2} \right)$$

$$p2 = 100 \times \left( \frac{44}{18} \right) = 244.45 \text{ W}$$

$$p2 = p1 \times \left( \frac{t1}{t2} \right)$$

$$p2 = 244.45 \times \left( \frac{48}{14} \right) = 651.87 \text{ W}$$

Here 0.8 is rev. on sprocket which is calculated as above.

$$p = \frac{2\pi nt}{60}$$

$$t = \frac{(p \times 60)}{2\pi n}$$

$$t = \frac{(521.5 \times 60)}{(2 \times 3.14 \times 27.4)}$$

$$t = 181.75 \text{ Nm}$$

### C. Calculation of Power Requirement

Compare with Newton's 2nd law of motion



$$F = m \times a$$

$$\text{And } T = F \times r$$

$$\text{So, } T = m \times a \times r$$

Assuming weight of cycle is 100 kg and shaft radius 0.015 m and for 40 km/hr. acceleration  $a = 11.11 \text{ m/s}^2$  (because  $1 \text{ km/hr} = 0.278 \text{ m/s}^2$ )

$$T = 100 \times 11.11 \times 0.015$$

$$T = 17 \text{ Nm}$$

Here 17 Nm torque is required to run the cycle.

Gear ratio is 1 : 1 having 200 mm diameter

#### D. Calculation of Spiral Spring

The spring dimensions are as below which is calculated in IST spring design software by trial & error method.

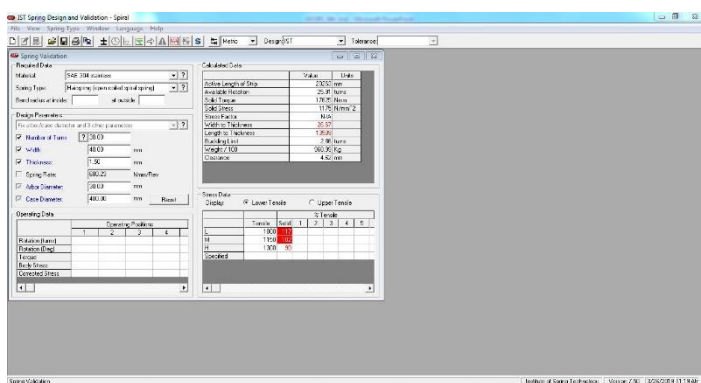


Figure 19: Result of torque & load by putting dimensions

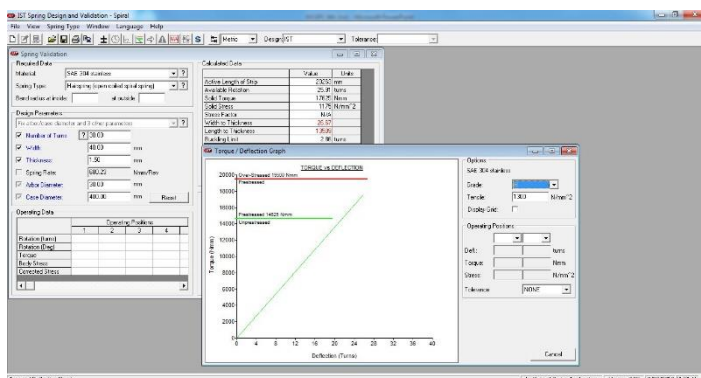


Figure 20: Torque vs. deflection graph of spiral spring

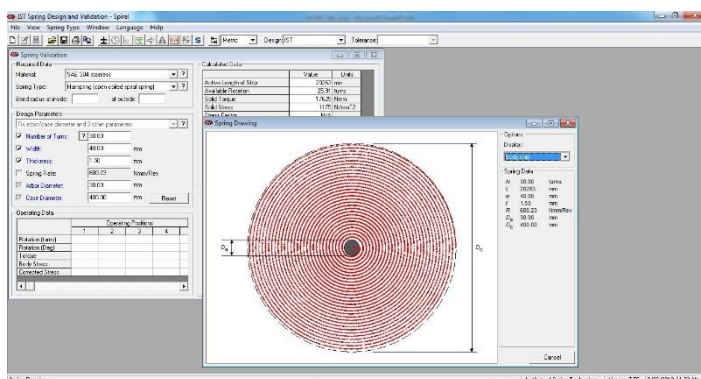


Figure 21: Dimensions of spiral spring

## VII. CONCLUSION

Thus, we can conclude that, our cycle operated by hand and stores power in spiral spring and uses it to drive and gives more rest to driver. This cycle is operated by hand so that it can also use by physically handicap people. Utilize the spiral spring to store the potential energy and use it whenever required and when spiral spring drives the cycle the driver can take rest. Rowing motion is better option for workout so, that for sportsperson this cycle is best for workout. Use of particular spring for we can get high speed rather than regular and geared cycles. This cycle has highest speed then other cycles. By regular effort we can travel more distance by use of spiral spring. It is more efficient. By use of spiral spring in rowing cycle for replacing constant effort in regular cycle and use the power of spring and gives the rest while driving the cycle. We can drive this cycle in any road condition. By use of aluminum frame this cycle has low weight.

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