THINK INDIA (Quarterly Journal)

ISSN: 0971-1260

Vol-22-Issue-2-April-June-2019

Fertilizer Sprayer Using Bicycle

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ABSTACT:

Chemicals are widely used for controlling disease, insects and weeds in the crops. They are able to save a crop from pest attack only when applied in time. The chemicals are costly. Therefore, equipment for uniform and effective application is essential. Dusters and sprayers are generally used for applying chemicals. Dusting, the simpler method of applying chemical, is best suited to portable machinery and it usually requires simple equipment. But it is less efficient than spraying, because of the low retention of the dust. We have proposed an equipment that has wheel and pedal operated sprayer, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel and also peddling the equipment. In this equipment using reciprocating pump and there is an accumulator provided for the continuous flows of liquid to create necessary pressure for the spraying action. The positions of the nozzles can be modified based upon user consideration. This wheel operated pesticide spray equipment consumes less time and avoids the pesticide coming from front of the nozzles which will in contact of the person who sprays pesticides.

I INTRODUCTION:

Farming is called as backbone of Indian economy. Farming is verycomplicated as it contains various Operations like weeding, sowing, harvesting etc. Apart from this it

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ISSN: 0971-1260

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has to depend on nature for various reasons like climatic changes. Because as climate changes it leads to change in growingconditions of plant in farms. These changes bring various diseases on plants which decreases productivity hence increases cost of production. Hence spraying operation to protect plants from diseases plays an important role in agriculture sector.

In last 50 years farming has undergone great evolution in spraying mechanism to control various diseases on plants. During initial day's farmers was performing hand operated spraying. Later there has been development of various methods to spray out fertilizers and pesticides. But with every development hopes of the farmers to increase productivity with minimum production cost increases tremendously. To fulfill these requirements various researches has been performed to limit wastage of pesticide and fertilizers as well as in mechanism of spraying machines. Generally, farmer uses traditional way that is spray carried on backpack and spraying crop this becomes time consuming, costly and human fatigue is major concern. Present day in agriculture the sprayers play an important role in spraying. Although sprayers vary like motorized, hand operated. Spraying pesticide is an important process in farming. Now days, there are many types of pesticide sprayer already in market. For the different types of pesticide sprayer there are have a different shape, sizes, method to carry it but the function are same. The current idea on sprayer in our project is to utilize effectively for reducing time of spraying, human efforts and cost of spraying.

1.1 Existing Spraying Techniques in Agriculture

1.1.1 Hand Sprayer

The hand sprayer is light weight low capacity pneumatic sprayer made of chromium plated brass tank. Basic principal of operation of this pump is has done by air pump which remains inside the tank. The sprayer has short delivery tube to which adjustable nozzle is attached. For spraying

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ISSN: 0971-1260

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tank is usually filled to about 70% of its capacity and pressurized by air pump. This compressed air causes mixture of pesticide to force out on operation of trigger. It is commonly used for small nurseries, small or household gardens.

Figure 1.1 Hand Pump

1.1.2 Knapsack Sprayer

Knapsack sprayer is medium capacity pump which consists of a pump and air chamber permanently installed in a 9 to 22.5 liters tank. This sprayer has harness that allows it to be carried on operators back. This pump is usually activated by moving a lever. The handle of pump is extended over the shoulder so as to make it possible for operator to pump with one hand and spray with other hand. Uniform pressure is maintained by c

Figure 1.2 Knapsack Sprayer

1.2 Problem Statement

For the backpack type pesticide sprayer, user needs to carry the heavy tank at the back and oscillate the lever that required more efforts. As we know, this is the most type of pesticide pump sprayer that user use in farming. User need to hold the nozzle when spraying out the pesticide. The second type of spray pump used is fuel operated spray pump, which is heavier than hand operated backpack pump. This type of pump is running on petrol engine. We know that petrol is one of the costly fuels. Also, the pump produces more vibrations which is hazardous to users' back muscles, these pump makes unwanted noise. A fertilizer sprayer has to be portable and with an increased tank capacity as well as should result in cost reduction, labour and spraying time. In order to reduce these problems, there are number of sprayers introduced in the market but these devices do not meet the above problems or demands of the farmers. The conventional sprayer having the difficulties such as it needs lot of effort to push the lever up and down in order to create the pressure to spray. Another

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difficulty of petrol sprayer is to need to purchase the fuel which increases the running cost of the sprayer. In order to overcome these difficulties, I have proposed a wheel driven sprayer, it is a portable deviceand no need of any fuelto operate,which is easy to move and sprays thepesticide by m

1.3 Methods to Overcome Problem

The conventional sprayer having some difficulties such as it needs lot of effort to push the liver up and do the farmer and he refuse to do such work repeatedly. In order to overcome these difficulties, we have proposed a wheel reciprocating pump, and nozzles which were connected at the front end of the spraying equipment. Also, the weeding is done by this equipment. In Agricultural sector use of cheap and beneficial equipment for effective weeding and spraying for increase productivity which is very important for better contribution for India's GDP. We have to make economic machineries sofarmers can purchase it as per capital i to sprayer is that farmers are using hand operated sprayer or motorized sprayer. According to idea in our project we are making a small agricultural reciprocating sprayer which is mechanically operated by a slider crank mechanism.

1.4 Spraying Technique

Most of the pesticides are applied as sprays. The liquid formulations of pesticide either diluted (with water, oil) or directly are applied in small drops to the crop by different types of sprayers. Usually the EC formulations, wet able powder formulations are diluted suitably with water which is a common carrier of pesticides. In some cases, however, oil is used as diluent or carrier of pesticides. The important factors for spray volume consideration are: The volume of spray liquid required for certain area depends upon the spray type and coverage, total target area, size of spray droplet and number of spray droplets. It is obvious that if the spray droplets are coarse-size then the spray volume required will belarger than the small size spray droplets. Also if the thorough coverage (eg. Both the sides of leaves) is necessary then the spray volume requirement has to be more.

1.5 Scope

Now days the spraying of crop is done by operator taking pump on back, but we were

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developing this conventional spraying for reducing efforts and time by using slider crank mechanism and motion transmission by chain and sprocketarrangement principles.

II LITERATURE SURVEY:

VISHAL GARG et al explained that spray mounted on any bicycle available in the market. A drum containing the solution is firmly attachedto the frameofthebicycle.Thereciprocatingp istonsareconnectedtothesprocketwith holding manifold can be folded back while not in use. The driving sprocket and the driven sprocket are interchanged from their usual position in a conventionalbicycle. The b sprocketarrangementistransferredtoa pumpassemblywhichpumpsairintothe tank to generate pressure for spraying through the sprayer nozzles.

Selection ofMaterials

To prepare any machine part, the type of material should be properly selected, considering design, safety and following points. The selection of material for engineering application is given by the following factors:

- Availability ofmaterials.
- Suitability of the material for the requiredcomponents.
- Suitability of the material for the desired workingconditions.
- Cost of thematerials.

In addition to the above factors the other properties to be considered while selecting the material are as follows

Mechanical properties

The properties are associated with the ability of the material to resist the mechanical forces and load.The various properties are:

1. Strength
2. Stiffness
3. Ductility
4. Malleability

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ISSN: 0971-1260

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- Hence cannot pick an arbitrary centre distance and chain pitch
- Nearest chain lengths (in pitches) for a contemplated centre distance C_C, are calculated by empirical formulae like (for a two sprocket system)

5. Brittleness
6. Hardness
7. Resilience
8. Creep

Ⅲ COMPONENTS USED:

1. Frame
2. Wheel
3. Chain Drive
4. Sprocket
5. Cylinder

3.1 Chain Drive DesignCalculation

- Chain must contain even integer number of links

Speed ratio:

$$i = \frac{2}{1} = \frac{44}{18} = 2.4$$

(PSGdesign datebook – 7.74)

Tip diameter of sprocket

$$1 = \frac{P}{\tan\frac{180^0}{z_1}} + 0.6\,P$$

$$= \frac{15.815}{\tan\frac{180^\circ}{18}} + 0.6(15.875)$$

$$= \frac{15.875}{0.176} + 9.525$$

= 99.525 mm

$$_2 = \frac{15.875}{\tan\frac{180^0}{44}} + 0.6(15.875)$$

= 221.96+9.525

= 231.485mm

1. Centre Distance (min & max value)

$$' = \frac{\mathbb{d}_{a_1} + \mathbb{d}_{a_2}}{2}$$

= 165.98cm

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For i=3 (psg design databook)

Minimum centre distance,

$_i$ = $'$ + (30 t 50)

= 165.98 +35

= 20cm

Maximum centre distance,

$_x$ = 80

=80*15.875

= 127cm

2. To find length of chain

$_P = \frac{^0}{} = \frac{34}{1.5875} = 21.25$

$(^P = 2\ _P + \frac{1 - 2}{2})$ $[(\frac{2+\ 1}{2\pi})^2]$ $+ \frac{}{P}$

74.3

1. Final centre distance

$= \frac{+\sqrt{\ ^2 - 8}}{4}$

$1 +\ 2$

$= \ _P - (\frac{}{2})$

e = 74 - 31 = 43

Z2-Z1 = 26 so, m is 17.2 = $\frac{43+\sqrt{43^2-8*17.12}}{4} * 15.875$

= 334.8 mm = 33.48cm

L= $_P$.

= 74 *15.875

=117.475 cm

Chain length for first drive

For second chain drive;

$\frac{44}{13} = 3.384$

$1 = \frac{15.875}{\tan\frac{180^0}{13}}$ = 64.4 + 9.525= 73.925mm

$_2 = 231.485$

$' = 152.705$

$_i = 1.2 * \ '$=183.246mm = 18.3 cm

$_x = 127$

$_P = 2(27.71)\ \frac{44+13}{2} + \frac{(\frac{44-13}{2\pi})^2}{27.71}$

+

= 55.43 + 28.5 + 0.878 = 86

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$= 86\text{-}28.5 = 57.5$

$= {}^{57.5} + {}^{\sqrt{57.5^2 - 8*243}}$ — —

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for ‘m’ value (PSG design databook)

$$\frac{4}{4}\frac{9}{5}\frac{9}{m}\frac{m}{=}\frac{4}{4}\frac{4}{.}\frac{9}{5}\frac{5}{c}\frac{c}{m}$$

L = $_P$.

= 86 *15.875

= 136.525cm

Chain length of second drive

For third drive ;

$$i = \frac{2}{1} = \frac{14}{14} = 1$$

Z = 14

3.2 Pump Specification

Connecting rod length = 19 cm

Piston length = 12 cm

Diameter of the piston = 11.5 cm

Length of the pump = 20 cm

Outlet diameter = 3 cm

Discharge;

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Diame ter of pump =

$$d = \frac{15.875}{\tan\frac{180°}{14}} + 0.67$$

$$' = \ _1$$

$$_i = \ ' + 50$$

$$_x = 127$$

$$_P = 2(35.9) + 14$$

=85.8

$$= 85.8 - 14 = 71.8$$

m = 0 (Due to same number of teeth)

$$a = \frac{p}{2} = \frac{71.8}{2}$$

$$= 35.9 * 15.857$$

= 569.26 mm = 56.9 cm

L = 1360.68 mm

= 136.06 cm

Chain length of third drive.

30mm

$A = \frac{\pi}{4}$ (^{2})= 706.858mm²

Speed ratio;

$$\frac{2}{1} = \frac{N1}{N2}$$

1. $\frac{44}{18} = \frac{N1}{100}$

N1= 244rpm

2. $\frac{44}{13} = \frac{244}{N3}$

N3= 72rpm

$A = \frac{\pi}{4}$ (i t r i ^{2})

=706.858mm²

v $ity = \frac{\pi DN}{60}$= 113.24 mm/s

Discharge ;

Q = A. V

= 706.858 *113.24 =80044.6 ^{3}

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1 Litre = 1000cm³

$$Q = 80044.6 * 10^{-9} \frac{^3}{}$$

$$= 0.08 -$$

$$= 0.08*60 \frac{}{i} = 4.8 \frac{}{i}$$

$$= 4.8*60 \frac{}{h} = 288 \frac{}{h}$$

3.3 Nozzle Discharge Calculation

Nozzle diameter $_1 = 30$

Nozzle diameter $_2 = 10$

$$A_1V_1 = A_2V_2$$

$$(\pi * 15^2)113.24 = (\pi * 5^2)V_2$$

$$V_2 = \frac{80044.63}{78.53} = 1019.2 \frac{}{}$$

$$_2 = A_2V_2$$

$$= 78.53 * 1019.2$$

$$= 80037.7 \frac{^3}{}$$

1 Litre = 1000cm³

$$_2 = 80037.7 * 10^{-9} \frac{^3}{} = 0.08 -$$

$$\frac{}{}$$

3.4 Sprocket Pinion

Sprocket is the major component of this system because it is power transmitting device. It gets power from the chain drive and makes this system to work. It is the device which transmits the linear motion of meshing chain drive

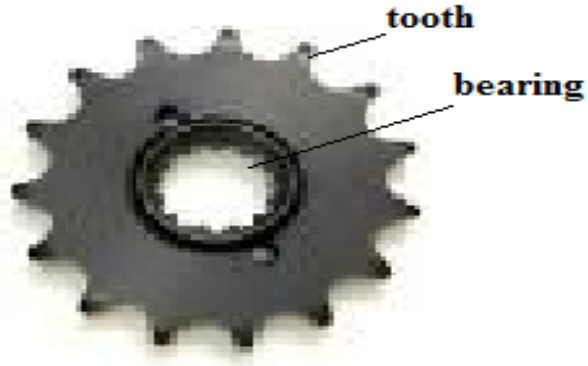


Figure 3.1 Sprocket with bearing

into rotary motion by means of the tooth found on it. The sprocket with ball bearings is said to be free wheel.

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Since it is a free wheel it allows the toothed part to rotate free from central portion in a direction. Hence this type of sprocket is used as the rear power transmission device in bicycle that makes the wheel to rotate and also allows toothed area to rotate in anticlockwise when pedaled anticlockwise direction.This action of sprocket allows attached lifting lever to adjust freely automatically or manually

$$= 0.08*60 \frac{}{i} = 4.8 \; _i$$

$$= 4.8*60 \; \frac{}{h} = 288 \frac{}{h}$$

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when it does not engage with pushing lever properly.

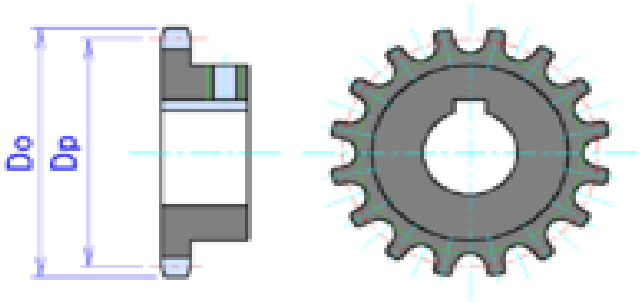


Figure 3.2 Sprocket with nomenclature.

Since the sprocket transmit the power from chain drive, it should have the capability to withstand the heavy loads of engine. So, to withstand those impacts on toothed area, it is made of high carbon steel. The ball bearings are made up of high chromium steel. Hence all these material gives following properties for sprocket.

- Heavy duty
- Smooth running
- Tempered
- Long life

Hence the sprocket is considered as

heart of this system.

3.5 Reciprocating Pump

A pump is a device used to raise, compress, or transfer fluids. The motors that power most pumps can be the focus of many

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best practices. It is common to model the operation of pumps via pump and system curves. Pump curves offer the horsepower, head, and flow rate figures for a specific pump at a constant rpm. System curves describe the capacity and head required by a pump system. An example of both of these curves may be seen in Figure 3.3.

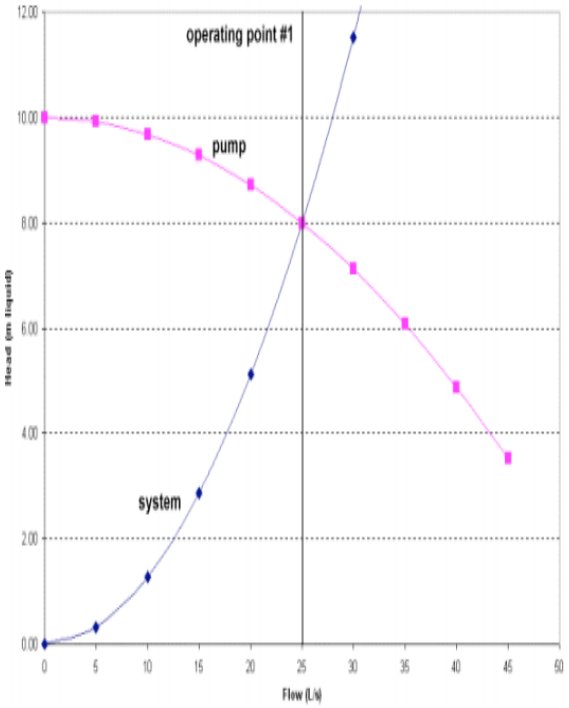


Figure 3.3 Example of pump and systemcurve

Pump operation may be modeled by a systemof affinity laws that show a relationship between rpm, flow rate, and power.

Understanding these basic relationships, shown below, is very important in considering the performance of a pumping system.

$$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

$$\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$$

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3$$

Q = *Flowrate*
N = *Speed*
H = *Head*
P = *Power*

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ISSN: 0971-1260

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VI WORKING PRINCIPLE

This fertilizer sprayer arrangement consists of fertilizer tank which stores the fertilizer for spraying purpose.This reservoir is connected to the hand pump which receives fertilizer form the tank and pressurizes it to flow through the nozzles.The outlet of the pump is connected to a nozzle through an adjustable pipe arrangement which resides the nozzle in it.The pump is activated byseparate chain drive which is powered by means ofpeddling of bicycle.

This chain drive arrangement can be installed at the time of spraying, then it transmits the rotation to the driving plate whichattached with the sliding rod of the hand pump.

So, this is converted into translation motion for the activation of the pump, due to this fertilizer stored in the reservoir gets compressed and the high pressurized content istransmitted into atmosphere through the spraying nozzles.

4.1 Design Analysis

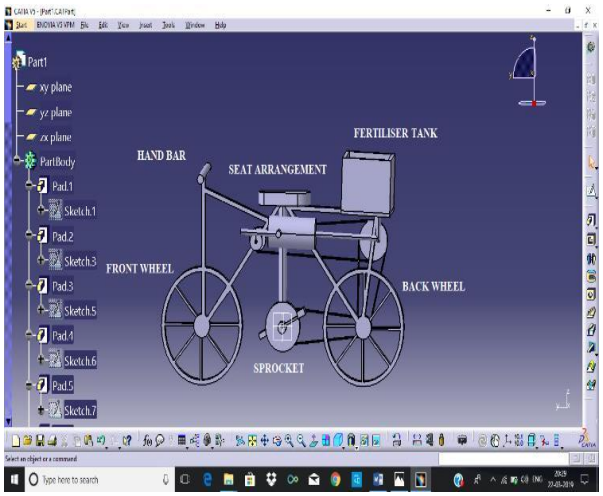


Figure 4.1 Left Side View

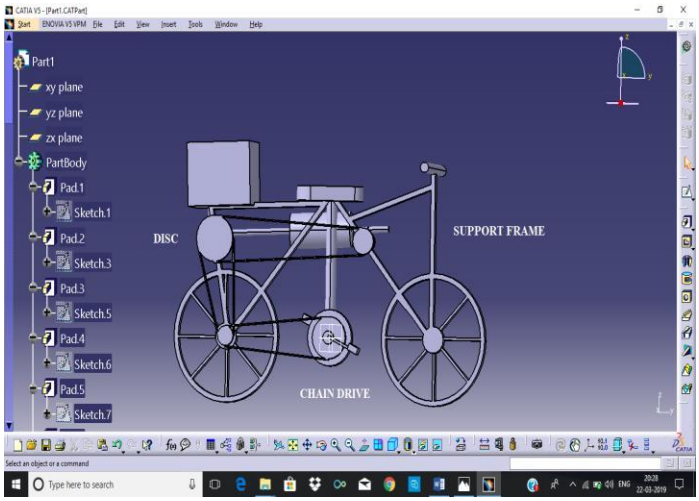


Figure 4.2 Right Side View

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ISSN: 0971-1260

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4.2 Advantages

- This sprayer is energy-efficient and easier to operate and maintain.
-

As it is a flexible product with adjustable height and width of spraying boom thereis grea ter flexibility for using it for various crops.

- Since the bicycle requires less space to move, it can be used in a more versatile manner as compared to power sprayers that are mounted on tractors.
- A labor-saving device, it can be used to spray one acre of land in 45 minutes thus covering more area compared to manual spraying.
- It is easy to assemble and dissemble.
- It serves the dual use of sprayer cum bicycle.

4.3 Applications

- For agricultural applications.

4.4 Pictorial Representation

Figure 4.3Fertilizer Sprayer Using Bicycle

V CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited

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ISSN: 0971-1260

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knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The "**FABRICATION OF FERTILIZER SPRAYER USING BICYCLE"** is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work.

Thus, we have developed a "**FABRICATION OF FERTILIZER SPRAYER USING BICYCLE***"*which helps to know how to achieve low cost automation. The operating procedure of this system is very simple, so any person can operate. By using more techniques, they can be modified and developed according to the applications.

References

- R.S.Khurmi "Design of Machine Elements", Eurasnia publishing house 3 Pvt Ltd, 14th revised edition.
- Human Power Flywheel Motor."-A past review, Proceedings of the 1st International and 16th National
- S.M.Moghe&K.S.Zakiuddin (2013) "Design and Development of Turmeric Polishing Machine Energized by Human Power Flywheel Motor."-A past review,

 Copyright ⓒ 2019 Authors

ISSN: 0971-1260

Vol-22-Issue-2-April-June-2019

- Conference on Machines and Mechanisms IIT Roorkee, India, Dec 18-20 2013
- Bicilavadora: The Pedal-Powered Washing Machine - IDEAS 2005 Proposal.
- http://en.wikipedia.org/washingmc/pedal-powered-washing-machine.html
- http://www.ideafinder.com/history/inventions/washmachine.html
- http://home.howstuffworks.com/washer1.html
- http://www.apparelsearch.com/definitions/miscellaneous/washing_machine.html

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