Water Pumping Windmill

Earliest Windmill Design 900 A.D.

- Persian Windmill 500-900 A.D.
- Panemone design
- Very inefficient

http://telosnet.com/wind/images/panemone.jpg
Daniel Halladay

- Born in Vermont in 1826
- Invented the self-governing windmill in Connecticut in 1854
- Manufactured windmills in Ellington, Connecticut from 1854 to 1863
- Sold thousands of windmills to farmers
- Finally moved his factory to Batavia, Illinois

http://farm4.static.flickr.com/3366/3412987586_6de4b396cf.jpg
Daniel Halladay’s Self-Governing Windmill

- Invented in 1854
- Automatically turned to face changing wind directions
- Automatically controlled its own speed of operation
- Used to pump water for cattle and irrigation

http://www.windmillersgazette.com/history.html
Solid Wheel Windmill - 1867

-Invented by Reverend Leonard H. Wheeler in 1867

-More rigid design composed of a fastened wheel attached to a hinged vane

-Major competitor of Daniel Halladay
Metal Windmill 1870’s

- Had curved blades which were much more efficient

- Had “back geared” system which made it turn easier in lighter winds

- People didn’t like them at first because they seemed fragile and difficult to repair

- By 1940 all windmills were made from iron and steel

http://thumbs.dreamstime.com/thumblarge_466/1262391144JfNKf4.jpg
Super High Tech Windmill 2011

-Made with strong anti-rust metal

-Bike wheel and tape design for extra durability

-Creates beer*

*does not actually create beer
How it works

Basic Components
- Rotor/Fan
  - Converts wind energy into rotary motion
- Gear Box
  - Converts rotary motion of fan into reciprocating motion
- “Sucker Rod”
  - Reciprocates to power underground pump
- Pump
  - With each motion of the sucker rod, draws water upwards through a one way check valve

http://www.do-it-yourself-pumps.com/windmill-animation.gif
Fan and Tail

- 15-40 curved, steel blades
- Fan guides apparatus which pivots so that it always faces the wind

http://www.uh.edu/engines/aeromotorsmall.jpg
Typical Gear Box

- Key component in converting rotation of the fan into up and down motion of the “sucker rod” to power underground pump

http://www.ironmanwindmill.com/how-windmills-work.htm
Hydraulic Pump

- Water drawn into pipe with upward motion of sealed plunger
- One-way valves prevent water from exiting through intake
- As plunger travels down, water is forced up toward surface

http://www.aermotorwindmill.com/Links/Education/Index.asp

http://www.windmills.biz/windmill%20pump.gif
Building a Windmill

Easier said than done
Materials

- Bike Wheel
- 2 chain rings
- Bike chain
- 2 Check valves with PVC
- Some sort of structure
- Scrap metal
Tools

• Welder
• Grinder
• Screw driver
• Crescent wrench
• White lithium grease
• Hammer
• Garden Hose
• Hack Saw
How It Works

• Wind spins the bike wheel which moves the chain
• Turning the bottom chain ring and the shaft
• Pump goes up
• Check valves create suction that brings the water into the PVC
• Pump goes down, pushing water out the second check valve
Ideas

• YouTube
  – http://www.youtube.com/watch?v=ITXqFe_aG1I&feature=related
  – http://www.youtube.com/watch?v=IHkEPx0hj4Y&feature=related

• Google Images
Current Manufacturing

- Usage of water pumping windmills has declined since the early 20th century
- By the 1970’s only three companies still produce water pumping windmills

http://www.bakermonitor.com/content/about-us/company-history
http://www.aermotorwindmill.com/
Current Usage in United States

• Domestic water on many Amish settlements
• Storage water in the Southwest U.S
• Water for livestock in Great Plains


http://fineartamerica.com/featured/native-american-windmill-harry-spitz.html
## Worldwide Usage

<table>
<thead>
<tr>
<th>Region</th>
<th>Units</th>
<th>Effective MW</th>
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<tbody>
<tr>
<td>Argentina</td>
<td>600,000</td>
<td>150</td>
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<tr>
<td>Australia</td>
<td>250,000</td>
<td>63</td>
</tr>
<tr>
<td>Brazil</td>
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<tr>
<td>China</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>U.S Southern Plains</td>
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http://books.google.com/books?id=1ZKky0XK6iUC&printsec=frontcover&dq=wind+power+renewable+energy+for+home+farm+and+business&hl=en&ei=A5qvTaQ5Kcma0QGv_-_mjcQ&sa=X&oi=book_result&ct=book_thumbnail&resnum=1&ved=0CEAQ6wEwAA#v=onepage&q&f=false
Advantages

- Wind is essentially an unlimited resource
- Clean source of energy
- Facilitates storage of water
- Can double as an electric fence
- Low cost

Disadvantages

• Outdated
  – Use of electric pumps delivering 20-30 gallons a minute hurt the windmill era
• Dependent on wind
• Small margin for error
Conclusions

• Windmill needs a strong wind to work
• Pumps little water at a time
• Air/water tight seals very important
• Friction is the enemy

• http://fineartamerica.com/featured/native-american-windmill-harry-spitz.html

• http://www.backwoodshome.com/articles2/ainsworth90.html3

• http://www.lonelyplanet.com/usa/pennsylvania/images/amish-farm-and-windmill-pennsylvania$18726-6