

## Bicycle powered water pump

### Bicycle Powered Water Pump

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This paper discloses a novel application for a standard bicycle trainer and a simple water pump to pump water at flow rates of 2 to 6 GPM while developing pressures from 4 to 17 PSI. This is a bicycle powered pump, which allows the use of a standard bicycle to be mounted in a trainer and used to power the pump. When finished pumping, the bicycle may be quickly released from the trainer to be used in its normal transportation mode. The trainer can fit most 700c, 650c, 20", 24", 26", and 29" and be adjusted so that the bike is level during operation.



Figure 1: Shows bicycle mounted in the trainer being pedaled to operate a simple lawn sprinkler.



Figure 2: The trainer with the fluid resistance unit mounted to the roller. This fluid resistance unit was removed and the water pump attached in its place. This unit is manufactured by Kurt Kinetic, who were very helpful in getting me a unit set up without the resistance unit. ([www.kurtkinetic.com](http://www.kurtkinetic.com)).

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Figure 3: Jabsco Model 1673 series self priming water pump. Steve vonDerAhe of Sea Chest New & Used Boat Gear in San Diego, CA recommended this pump. Steve understood my application and recommended a good fit for the requirement. The pump gives good performance at low rpm.

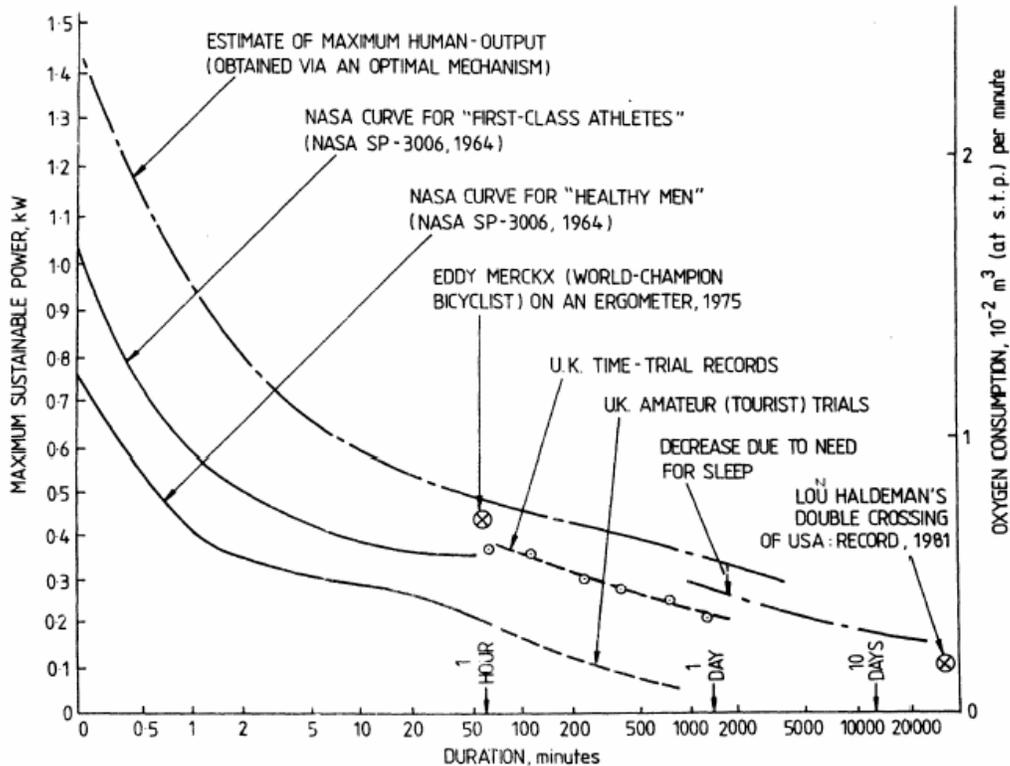


Figure 4: Chart shows various power/duration curves for human activities. The NASA Curve for Healthy Men shows that a power output of ~250 W for an hour is possible. 250 W is approximately 1/3 hp.

Table 1 is taken from the data sheet from the Jabsco Model 1673-1003 pump. It shows that even 1/6 hp at 500 rpm can pump 2.2 gallons per minute into a pressure of 4.3 psi (10 ft. elevation) and 1/3 hp at 1750 rpm can pump 6 gpm into 13 psi. These two settings are close to the limits of the capability of the system.

Table 2 shows the bicycle capability for a 24 speed road bicycle using a pedal cadence of 60 rpm. The range of pump rpm as driven through the trainer ranges from approximately 500 to 1800 rpm, which fits the pump model 1673-1003 pump well.

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Table 1: Model 1673-1003 pump data

Total Head		500 RPM		1160 RPM		1750 RPM		2100 RPM	
PSI	Ft. of Water	GPM	HP	GPM	HP	GPM	HP	GPM	HP
4.3	10	2.2	1/6	5.8	1/4	9.5	1/4	11.5	1/3
8.7	20			4.3	1/4	7.6	1/3	9.4	1/3
13.0	30			2.5	1/4	6.0	1/3	7.4	1/2
17.3	40					4.2	1/2	5.6	1/2
21.6	50							3.9	1/2
26.0	60								

Table 2: Data for 24 speed bicycle (Giant model FCR4) .

Teeth in chain wheel	Teeth in rear cog	effective wheel diameter	Bicycle wheel rpm at pedal cadence of 60rpm	Pump rpm (4" diameter roller)
52	12	119.2	260	1788
42	13	110.0	240	1650
30	15	95.3	208	1430
	17	84.1	184	1262
	19	75.3	164	1129
	21	68.1	149	1021
	23	62.2	136	933
	26	55.0	120	825
		96.3	210	1444
		88.8	194	1333
		77.0	168	1155
		67.9	148	1019
		60.8	133	912
		55.0	120	825
		50.2	110	753
		44.4	97	666
		68.8	150	1031
		63.5	138	952
		55.0	120	825
		48.5	106	728
		43.4	95	651
		39.3	86	589
		35.9	78	538
		31.7	69	476

With the above information used to select the pump and diameter of the trainer roller, the rest of the project was simply to build a bracket to hold the pump to the trainer roller shaft. Thanks to Paul Winberg of Austin for advice and machining to make the system work.

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Figure 5: The roller assembly from the trainer with the fluid resistance unit and flywheel removed. The roller is approximately 4" in diameter. The roller assembly attaches to the trainer and the rear wheel of the bicycle rides on the roller, and turns it when the bicycle is pedaled.

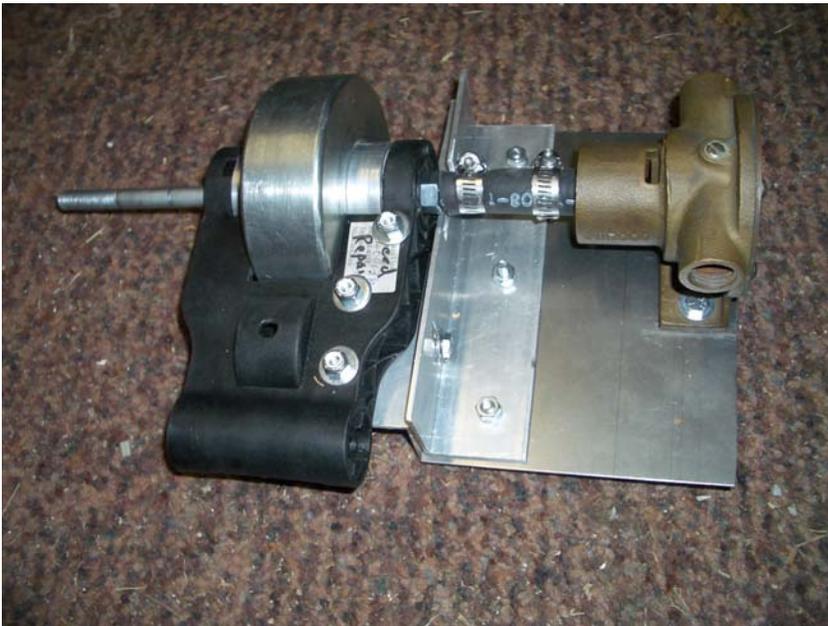


Figure 6: The pump unit mounted to a bracket which attaches to the trainer roller assembly. The pump shaft is coupled to the roller shaft with flexible hose to allow for run out.

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Figure 7: Pump connected to the bicycle. The plate on the left side of the roller assembly is a flywheel that helps smooth the power requirements.



Figure 8: Ready for action. The white hose (input) is connected to a rainbarrel, the green hose to a lawn sprinkler.