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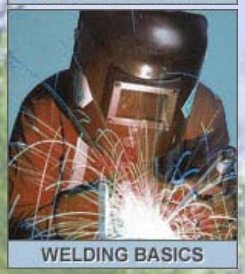
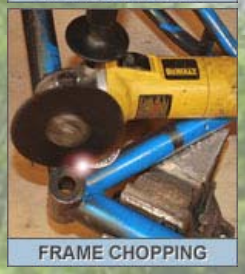
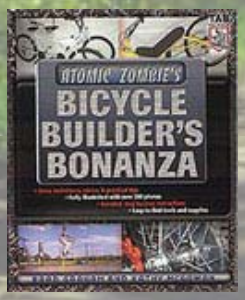
The Lost Files





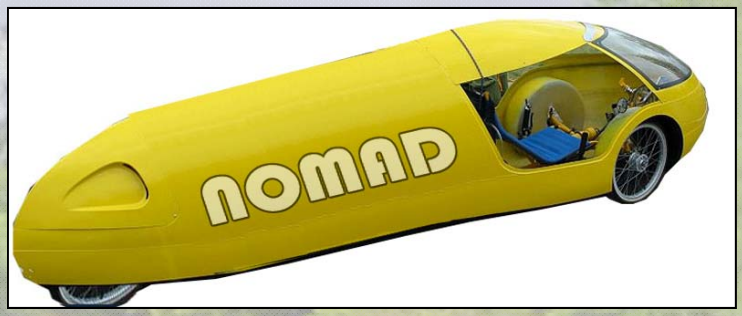


By Radical Brad

The Nomad Cross Country Trike

I have always wanted to create some kind of human/electric powered cross country vehicle that would allow a person to travel great distances over the course of weeks or months. Using a combination of solar and human power for energy, the vehicle would be able to cross several hundred miles per day on a decent sunny day. The cabin would have enough room to sleep and offer a place to carry supplies, all in a very aerodynamic shape to help cut through wind resistance.

To achieve any kind of aerodynamic advantage, a fish shape is necessary, so the obvious configuration would be a tadpole trike - two wheels up front and one in the rear. I found a photo of a faired trike on the web and then butchered it up in Photoshop, extending the body so that there would be a 6 foot length between the back of the seat and the rear wheel, creating a cabin area. The vehicle would also have to carry a few cubic feet of food, water and supplies in order to allow the rider to stay fueled between rest stops, which could be a matter of days depending on the weather.



A Photoshop mockup of the Nomad tadpole style trike

As for the motor part of the transmission, I had not worked out the complete plan, but I wanted to have the entire top covered in flexible solar panels and use the best lithium battery packs available. The rear wheel would have an integrated hubmotor laced into a 20 inch wheel for the best combination of speed and torque. I also wanted to experiment with generator drive, a human input feed generator, rather than directly into the rear wheel through a chain. I knew this would be less efficient, but would allow a constant level of effort at all times as the computer controlled the charge and load on the human powered pedal generator.

I started with the front steering buts, which are always the most complex parts of a tadpole trike to build. This was only a prototype, so things were done in the usual garage hacker manner, using whatever I had

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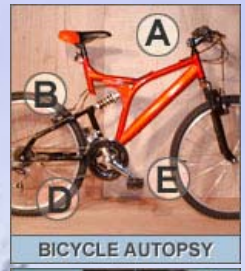
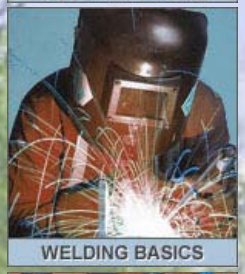
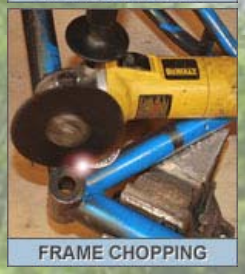
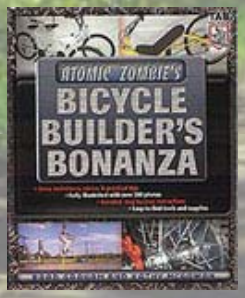




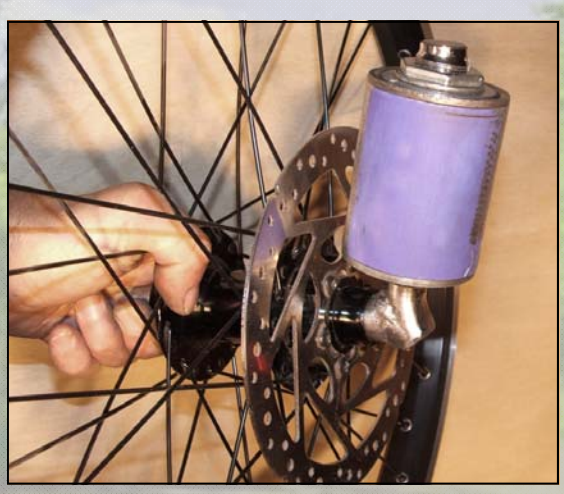




The steering parts to carry 20mm axle hubs

laying around, rather than heading to the machine shop with wallet in hand. I cut up some 1 piece cranks and welded some 20mm hollow tubes to the crank axle so that a set of 20 inch front wheels with 20mm hollow axle hubs could be installed. I liked these wheels because they included disc brakes, and I knew if I finished this trike, it would be topping the scales at more than 200 pounds once fully loaded.

The steering pins would be carried by the bottom bracket hardware, which included a fairly robust pair of ball bearings. This steering system was tested and did appear strong, but I was a little concerned by the heat affected weld zone between the hub support tubes and the crank axle since the crank axle might have been hardened steel.



Disc brake wheels installed on the steering hardware

Of course, this was only a test rig, and if I decided to create a working model, sealed cartridge bearings and re-designed kingpins would be used.

Proper front steering includes something called “caster angle” and “center point”, which allows the front wheels to turn at their center point where the tire hits the road. To achieve center point, the axis of the steering axle is

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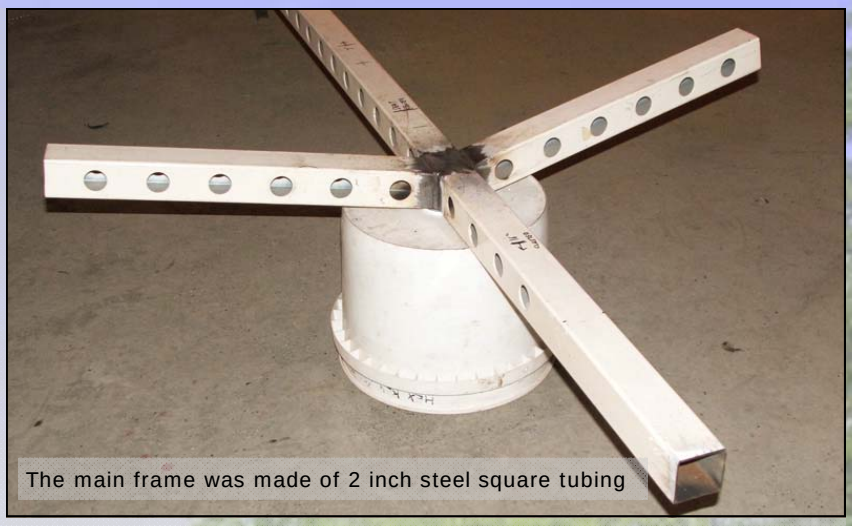

The main frame was made of 2 inch steel square tubing

tilted so that an imaginary line extends through the axle right to the center of the tire where it hits the road. Vehicles with two front wheels include center point steering.

"Caster angle" is the slight forward inclination of the steering axle, which allows the wheel to self center under load. This system can be seen on any normal bicycle as well and is called "head tube angle". Having center point and caster angle will make a very agile yet responsive steering system on a trike. Of course, this trike would never really reach high speeds, but that is no excuse to cut corners and create a twitchy steering system.

I had an old weight set that offered a lot of good 2 inch steel square tubing, so I cut it up to make the main frame. The tubing had 1 inch holes drilled in the side walls which made it slightly lighter, but this would also mean moisture could get into the tube. Being only a prototype, this tubing would be fine for initial testing, but a final version would use new square tubing and probably also include a suspension system worked into the frame design. Besides being 12 feet long, this frame has the same basic shape and angles of any tadpole trike frame, placing the rider between the two front wheels. The track width would be around 3 feet so that there would be enough room to move around and sleep comfortably in the cabin area.

The overall length of the Nomad with wheels installed was a whopping 12 feet or more! Of course, length was much better than width for a vehicle that would have to ride along the expressway as it traverses the country from one town to the next. At slightly less than 3 feet wide, the Nomad could pull to the shoulder as cars passed, and it would be very difficult to miss such a large cycle on the road. So, in a way, the Nomad would be a lot safer as a distance commuter than a road bike crammed to the max with saddle bags.

The turning circle of the Nomad would obviously be huge, probably about the same as a large pickup truck. The trike could easily navigate city streets, but would need to have both forward and reverse if ever having to

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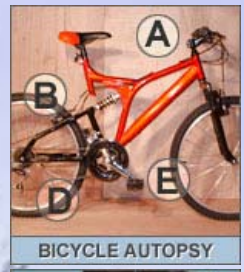

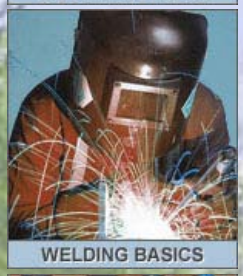

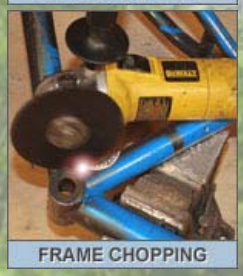

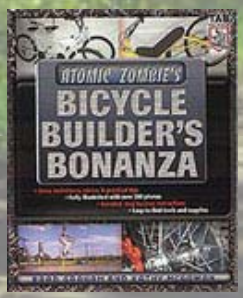

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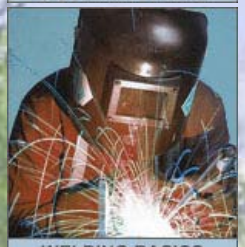
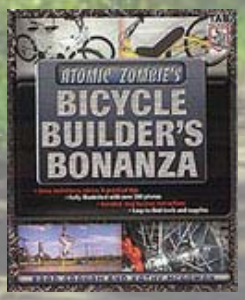
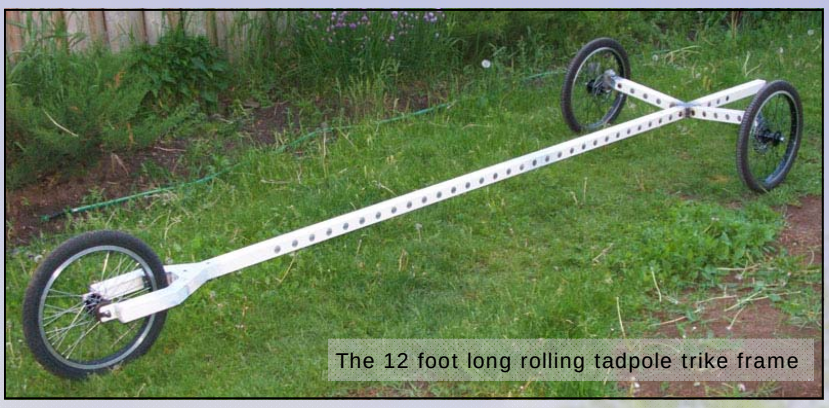
BICYCLE AUTOPSY



WELDING BASICS

FRAME CHOPPING





The 12 foot long rolling tadpole trike frame

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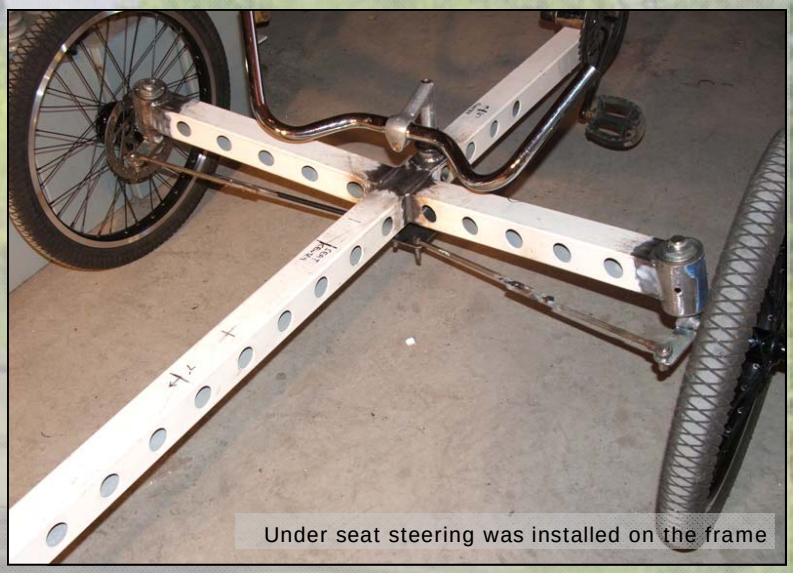
turn around on a street. Since a cycle hubmotor cannot run in reverse, some kind of bomb-bay type doors in the floor would be needed so the pilot could drop their feet and roll the vehicle backwards when necessary. Kind of crude for sure, but the goal is to go long distances, not make all kinds of short maneuvers and u-turns.

To allow the pilot to easily climb in and out of the cockpit, under seat steering was installed. The sides of the front cockpit will be open, but have zipper sides so in cold weather heat can be retained. The desired seat height will be about 20 inches from ground level, giving the pilot a clear view of the road ahead and allowing for plenty of headroom in the tapered rear cabin area. The steering system takes into consideration "Ackermann geometry", which allows the wheel on the inside corner to turn at a sharper angle than the wheel on the outside of the corner. Since the inside wheel makes a tighter circle, this compensation is necessary in order to avoid dragging a wheel in a corner. All vehicles with two front wheels have Ackermann type steering.



Under seat steering was installed on the frame

The steering hardware is made of common bicycle components, head tubes, fork stems, a gooseneck, and

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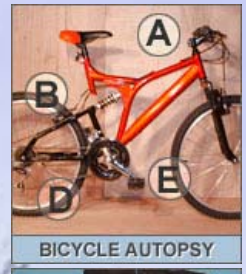
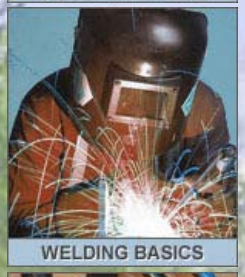
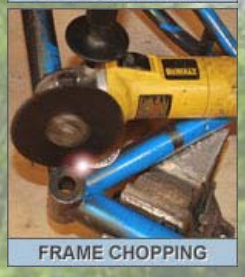


BICYCLE AUTOPSY


WELDING BASICS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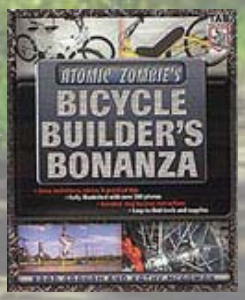


Experimental generator drive uses electron flow instead of a chain

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handlebars. The steering linkage is formed using steel connecting rods and spherical bearings (ball joints) at the ends of the rods. The seat will be placed on a hinged tube that will give it a bit of suspension, since the rest of the frame does not include any kind of suspension system.

The strangest part of the Nomad experimental trike is the transmission system, which does not include a bicycle chain. The goal was to design an onboard computer system that would take care of the battery bank, solar input, as well as route power from a pedal powered generator into the bank as needed.

This system would allow the pilot to always pedal at a constant and relaxing level while the motor controller powered the rear hubmotor drive as necessary. Climbing massive hills would seem no different to the pilot than rolling along the highway, and the energy from the generator would trickle charge the battery bank along with the output from the flexible roof mounted solar panel array.

My initial pedal generator was made using an efficient permanent magnet motor connected to a gear reduction unit. Human input of 60 to 90 RPM would generate about 50 volts unloaded, and what seemed to be the perfect voltage to directly drive a rear hubmotor. Efficiency was not all that great when trying to get moving, but once rolling, the drive system did feel quite smooth. I tried several generator variations, connecting directly from the generator to the hubmotor just to check efficiency. Sadly, I have no more photos of this prototype, although I did have it somewhat working.

The ultimate pedal generator was actually another hubmotor - a brushless 400 watt rear hubmotor. The efficiency of the hubmotor as a generator was astounding! With one hubmotor running the other directly, it almost felt like a direct drive using a chain; this was extremely promising. I will probably experiment more with generator drive in the future due to what was learned here.

Now, what about the Nomad? Well, I needed room in my garage and ended up taking it all apart! I had decided that such a vehicle would definitely need suspension, and would probably go as far as to include a set of retractable pontoons and actually make the Nomad fully amphibious, able to cross small lakes as well! If I

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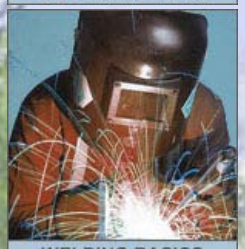
re-visit this project in the future, I will take what I have learned in this prototype and add all of those features I want in the final version: generator drive, efficient lithium battery pack, roof mounted solar panels, onboard smart controller electronics, a spacious sleeping cabin, and even retractable pontoons and a propeller for fully amphibious operation.

BICYCLE AUTOPSY



WELDING BASICS

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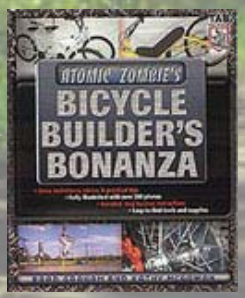

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