

My Van's RV-4 is a reasonably light airplane to push around, but not so with my wife's Cessna 172. I can barely push it back into its parking place, which is up a slight incline. When she flies alone after hours, there usually isn't anyone available to help her put the airplane away.

Buying a powered tow hook would be nice, but they're expensive: about \$500 and up. Even the ones that use your own cordless drill seemed a little pricey to a frugal person like me. When typical homebuilders finish their projects, they are many times short on



Here's the final powered tow hook attached to the Cessna 172. Intended to be an assist only, the author says the tow can actually move the airplane itself.

Build a Powered Tow Hook for \$10

Scrounging parts and rummaging through the scrap pile isn't just fun—it can pay off.

BY JIM FLEISCHMAN

cash but long on tools and ingenuity. I figure every dollar saved is another dollar's worth of avgas. It was time to go shopping at my favorite store, the one that had my folding bike (See "Folding Airport Bike for Free" in the September 2003 issue of KITPLANES®)—the dump.

The Parts List

Partial multi-speed bikes are as plentiful as complete ones and are less shameful to cannibalize, and chain and gears were needed for this project. I also scrounged an electric windshield wiper motor. Almost any make will do, but this one was out of an '89 Ford F-250 pickup. (Vehicles that use larger wiper blades usually have more powerful motors.) These typically have a worm gear reduction drive and large armatures, and they sometimes have wiper arms that simply unbolt, making replacement with a chain gear easy. I was also able to scavenge an electric window switch (reversible rocker type out of a Volvo), which saved a few bucks.

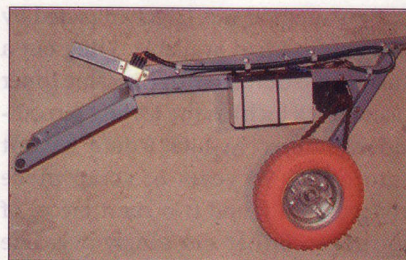
A computer UPS (uninterruptible power supply) usually has 24 volts or more made up of multiple 12-volt batteries. When they are tossed out, it is rare that every battery inside is dead at the same time, and that is where I found a serviceable 12-volt sealed lead-acid rechargeable battery. I did break down and buy an 8-inch pneumatic wheel/tire combination from Harbor Freight (www.harborfreight.com) for \$5 on sale. I also added a few nuts and bolts and numerous bits and pieces from my scrap steel bin.

How to Build One

The first step is to mate one of the bicycle gears to the wheel hub. Try to select one that is close to but less than the outside diameter of the tire. You don't want it too large or the chain will rub on the ground when the tire is compressed. I centered the gear on the hub as well as possible and fastened it using three $\frac{5}{16}$ -inch bolts with spacers long enough so the chain would not rub on the tire. I drilled straight through the

wheel hub to mount this, lining up with the holes in the bike gear that formally had rivets. The wheel hub had a $\frac{1}{2}$ -inch axle hole that a bolt of that size would have worked on, but I happened to have a chunk of $\frac{1}{2}$ -inch rod stock that served as well. I welded the axle to some 1-inch-square thin-wall tubing for a frame. (I had an ample supply of end pieces but had to join more than a few to make anything of length.)

The next step was to make a small spur gear for the chain that would attach to the output shaft of the wiper motor. I wasn't sure how difficult this step



The tow hook can fold for storage in the baggage compartment. Folded length is 31 inches; it weighs 19 pounds with a battery.

PHOTOS: JIM FLEISCHMAN

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\$10 Tow Hook

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would be, but it turned out to be a snap. The chain happened to have a half-inch pitch (the measurement of link pin to the next link pin) with $\frac{3}{8}$ -inch rollers and a gear width of just over $\frac{1}{2}$ inch. A six-tooth gear turned out to be the smallest I could realistically make. I took a compass and drew a half-inch radius circle. I drew a line through the center of the circle, centered the compass on the intersections of that line with the circumference and drew four more marks on the circumference with the same half-inch radius. I center-punched the six points on the circumference and the circle center and drilled a $\frac{3}{8}$ -inch hole in each.

Use a coping saw to cut between the $\frac{3}{8}$ -inch holes, then trim and sharpen the teeth to resemble the bicycle gear teeth. Precision in the layout is critical, but the manufacturing goes quickly. The $\frac{3}{8}$ -inch center hole was the approximate size of the output shaft that comes off the wiper motor, but it needed to be filed into a square hole to match up. The bolt that held on the wiper arm is now used to hold the gear on.

I drilled holes in the steel-tube framework to match up with the motor's original mounting pads and mounted it in a convenient position. Spacers and correspondingly longer bolts were used to line up the motor gear and wheel gear. I customized chain lengths by simply punching out a link pin at the desired length and re-pinning the end over after reinsertion. The chain final length may determine the exact motor mounting point within a few tenths of an inch, so be careful.

Next I had to come up with a way to attach the framework to the towing pins on the front landing gear of the 172. There are many ways to do this, but my method was largely dictated by what scrap I had available. I dug out a short scrap of tube with the same inner diameter ($\frac{1}{2}$ inch) as the towing pin outside diameter. As luck would have it (more like 30 years of scrap piece collecting), I found two short pieces of square stock that slid snugly over one another. These I welded into a sort of sliding clamp to fit the $\frac{1}{2}$ -inch tube ends over the towing pins. It was quick, solid



These are the main components: (1) the bike gear attached to the wheel, (2) the battery the author found at the junkyard, (3) the spur gear attached to the wiper motor, and (4) the bicycle gears from the dump.



This is the rocker switch as it's attached to the handle.



This is the assembly of the two sliding pieces that clamp onto the nosegear tow pins. There is a tension spring inside that holds the two halves onto the nosegear.



Here's a close-up of the finished spur (six-point) gear, which attaches to the wiper motor.

and easy to attach. A tension coil spring inside the sliding pieces meant that all I had to do was pull the clamp slightly apart and let it snap back onto the plane's tow pins.

A pivot on the handle allows the

tow hook to fit easily in the luggage compartment. It folds up, but not down past center. That way one can push down on the handle to get more traction on the drive tire.

The wiring is pretty straightforward. Electric window switches are almost always momentary double position, double throw (DPDT) with six pins. The motor (or battery) will go to the center pins and what's left will go to one set of outer pins. The leftover outer pins will be wired crisscross to the first set of outer pins. As the switch is rocked one way or the other, it simply reverses the circuit (thus the motor direction).

Does it Work?

This tow hook was never intended to be more than an assist, meaning that one person can push on the propeller hub while using the tow with the other hand to do the work of a second person. It turns out that it will move the C-172 by itself on a slight grade—about the incline one would expect to see to keep water flowing away from a hangar—and do the steering to boot. The folded length is 31 inches, and it weighs 19 pounds. The battery can be charged with a cigarette lighter plug (on the way to the airport or in flight), or 25% of the weight can be saved by eliminating the battery altogether, using instead a long cord and the plane's cigarette lighter socket to supply the power. The unloaded travel speed is 15 feet per minute, which is not bad considering its portability.

The total cost invested was less than \$10 thanks to some creative scrounging, but some of the key components are available elsewhere. If you had to (I almost can't bear to say this) "buy new parts," try Cardone (www.cardone.com), popular re-manufacturer of automotive electronics. Also, most automotive supply outlets sell a wiper motor like the one I used for less than \$100 without a core. Mouser Electronics (www.mouser.com) has sealed lead-acid batteries similar to the 7AH one I found for about \$14. Mouser also has momentary "On" DPDT rocker switches for less than \$8.

But let's face it, where's the challenge in that when there's creative scrounging to be done? †