HERO Jr. RUNS AWAY:

FIX FOR WHEEL ROTATION DETECTOR FAULT.

H. Holden. June. 2018.

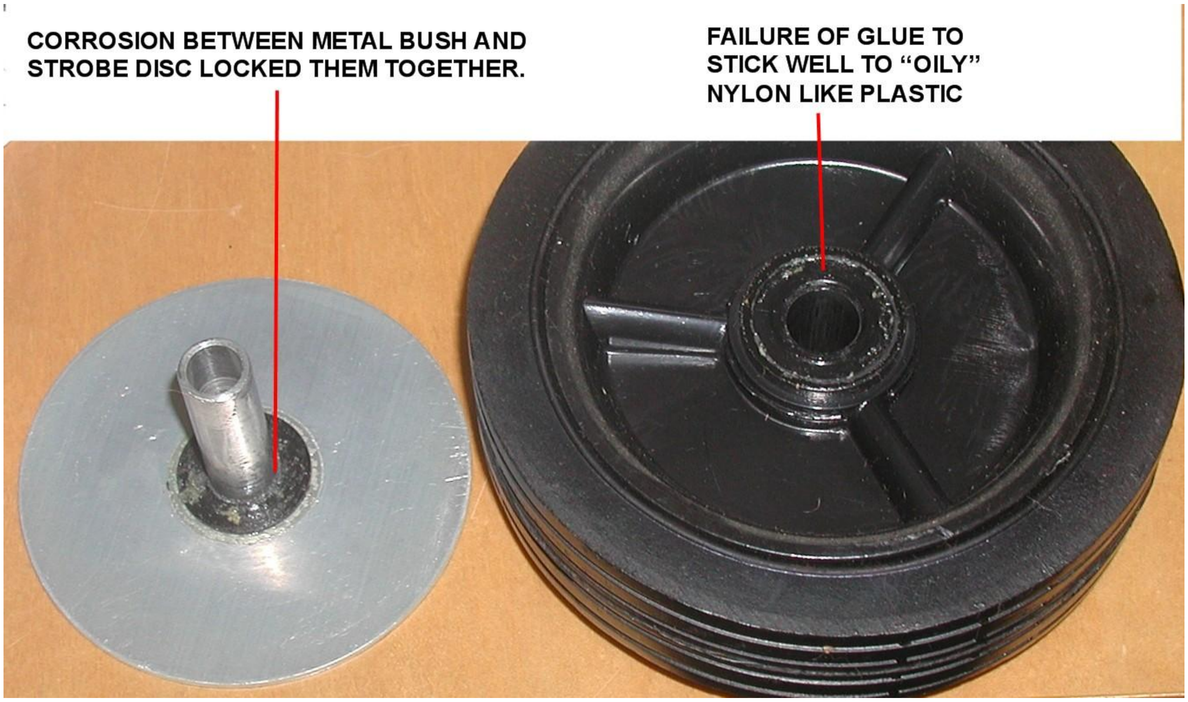
The Hero Jr. Robot has a wheel rotation sensor. If this sensor fails for any reason the Robot is unable to measure its progress forward or backward. However, both these sensor systems had failed in my two Robots. They appeared to be running fine, including the Demo mode that worked correctly. Also programs entered in the Hero Jr programming language, via the Robot's Keypad, which executes both start and stop commands to the motor, appeared to be working.

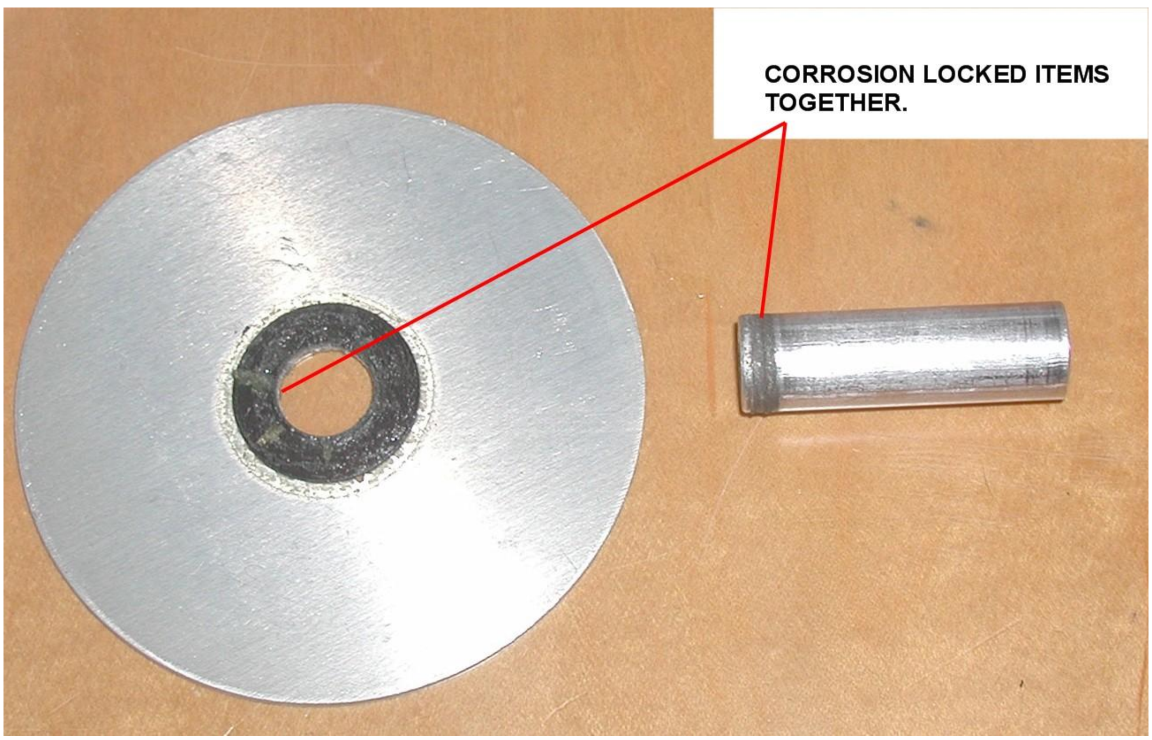
However, recently I connected my Robots up via an RS-232 link to a computer terminal to program them in Hero Jr. BASIC. In this BASIC the command for movement is issued as a statement of how many inches the robot is to move. I programmed the robot to move a few inches forward as a test. Upon executing the program the robot rushed off across the room, unplugging itself from the serial cable as it "escaped" and I had to run after it to reset it, before it crashed into the wall.

The reason it didn't stop moving, was because the BASIC program was expecting a certain number of "counts" from the rotation sensor on one of the Robot's wheels, which it did not receive. This rotation sensor is formed from a stroboscopic disc with 36 silver or black segments and an LED & Phototransistor assembly that are mounted close to the disc.

Inspection showed that while the wheel was rotating, the disc itself appeared frozen solid, even though it was supposed to be rotating with the wheel. On disassembling the wheel it became obvious how this had come about. Like many mechanical failures, a combination of circumstances had caused it.

The wheel itself runs on a section of aluminium tube or a bush that is bolted over the threaded rod which forms the axel. The bush is longer than the wheel hub and the stroboscopic disc thickness, so that when the wheel nut is tightened there is still some play. The wheel is retained by a nut and washers that secure the bush. The bush passes through the central hole in the stroboscopic disc and is supposed to be free from it. The stroboscopic disc is attached to the wheel hub with a rubber washer, glued on each side to the disc and to the plastic wheel hub. It was found that the disc's hole area had bonded itself to the bush (with corrosion) and the glue had failed in the interface between the washer face and the wheel hub. The two photos below tell this story:





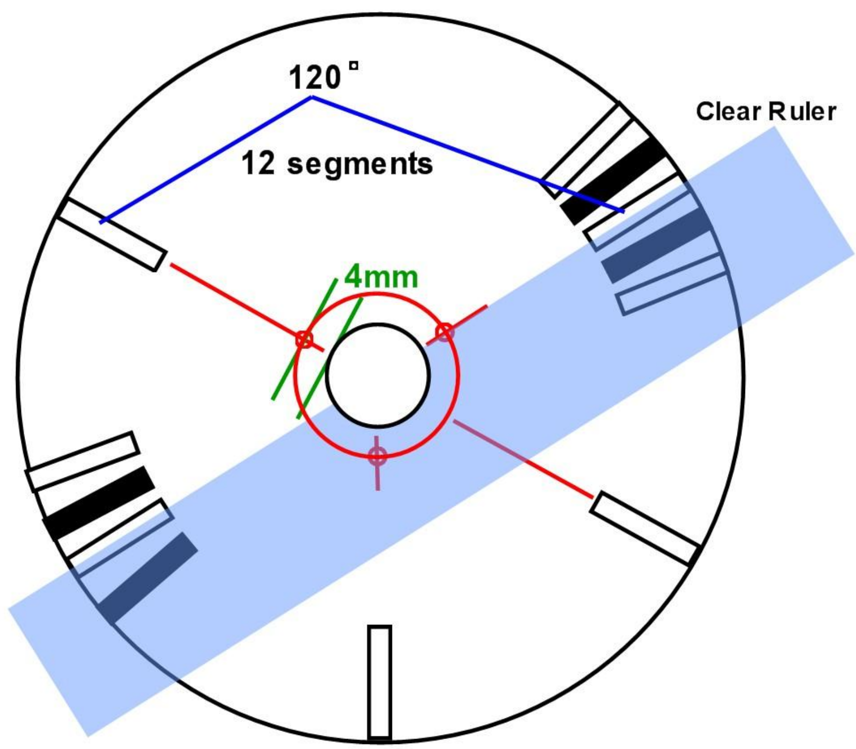
Inspection also revealed some other details. The wheel hub is made of particularly slippery plastic. I think it is most likely black Nylon. The glue used appeared to be a type of contact adhesive. While this worked reasonably well to glue the rubber spacer washer to the rear of the stroboscopic disc, it struggles to stick well to the wheel hub.

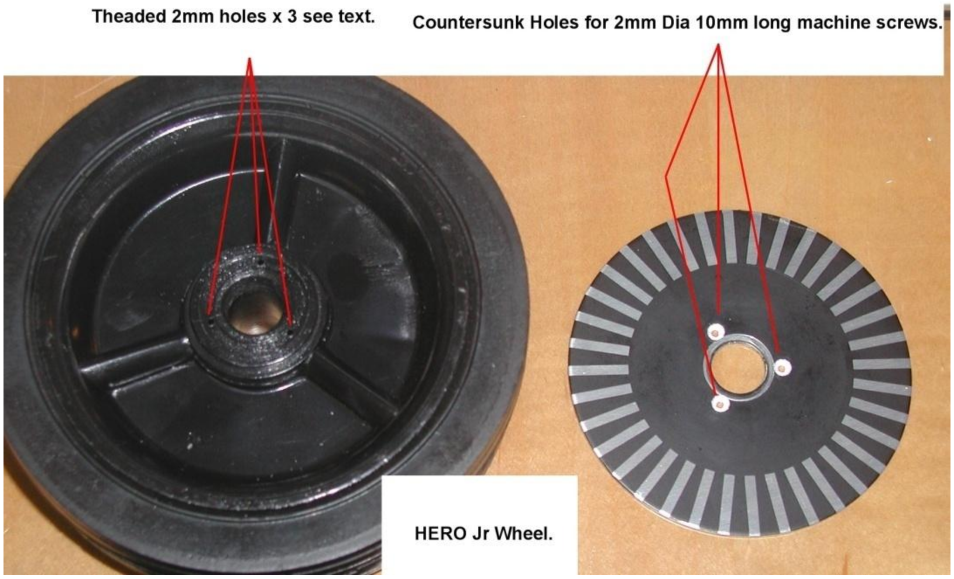
The manufacturers must have known about this difficulty because the plastic of the hub had been roughened a little where the glue was applied.

I have about 8 or 9 different types of glues available in my workshop and I experimented with them on the wheel hub, for good adhesion. None were particularly satisfactory. So I decided the stroboscopic disc should be mechanically fixed to the wheel hub.

Three 2mm diameter countersunk holes were made in the disc. Fortunately the process of placing them accurately was aided by the stroboscopic markings on the disc. The disc is divided into 36 segments between alternate silver and black areas. So it is very easy to measure a 120 degree spacing by placing a transparent ruler on the disc and making a very fine light scribe line near the central hole. Then from the inner disc hole edge, using dial callipers, a fine scribe line is placed across the initial line 4mm from the disc edge. Then under magnification with a small spike, each hole location is marked, then started initially with a 1mm drill in a had held pin chuck. Then three 1.5 mm pilot holes are drilled on the drill press in the stroboscopic disc.

When the above is done, the disc is placed in the wheel hub. The aluminium bush helps to centre it, and the 1.5mm drill is used to start the holes in the plastic wheel hub, using the disc as a template. It pays to place a small mark on the inside of the disc and the wheel hub, to make sure it is assembled in the same position. However, if the three holes were accurately placed in the disc, it could mount in any of the three possible rotational positions. The diagram below shows how to mark out the holes:

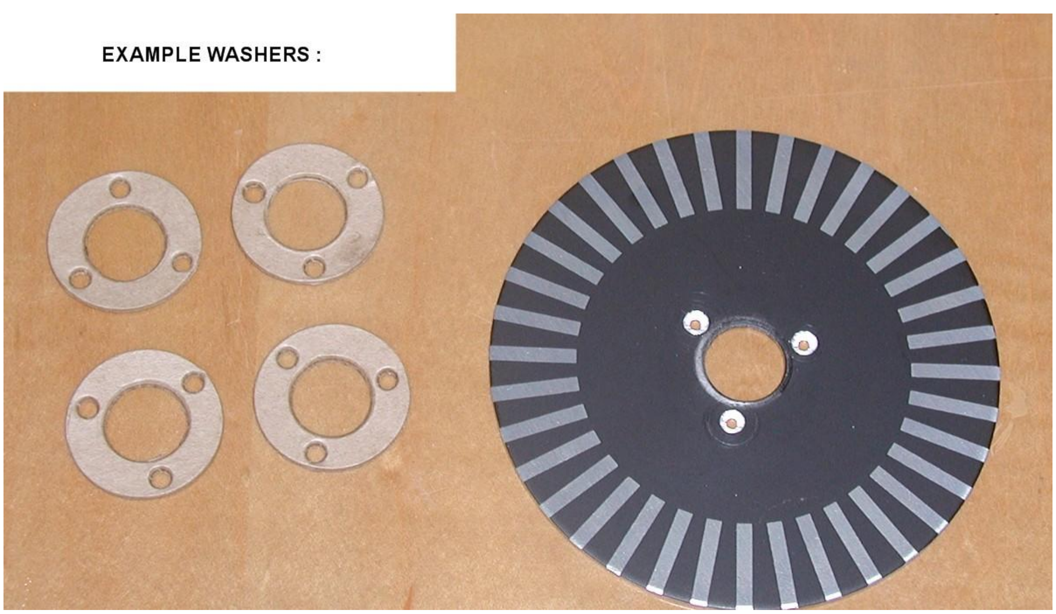




The 3 pilot holes in the wheel hub are then drilled to a depth of around 9mm with the 1.5 mm diameter drill. Once that is done a 2mm metric taper tap is used to start a thread into the initial part on the hole in the plastic hub, around 3mm deep. This allows the 2mm screw to start to screw in. Because the plastic is soft the 2mm screw makes its own thread as it is screwed into most of the 1.5mm diameter 9mm hole depth.

The holes in the stroboscopic disc are enlarged from 1.5mm to 2mm diameter and then countersunk, with a proper countersinking tool (**not** a drill) to accommodate the 3 fixing screws flush which are 10mm x 2.0mm metric CS types. (Using drills for countersinking is a risky shortcut, it creates the wrong taper and there is the risk of them accidentally passing through the full thickness of the material).

The Stroboscopic disc does need one washer behind it, between it and the hub, in the range of 1 to 1.5 mm thick. This is because the outer edge of the disc contacts the outer wheel rim before the central hub, when there is no spacer. One option could be to use the original rubber washer, but these were moderately degraded, so I simply punched some washers out of 1.3mm thick transformer cardboard:



The picture below shows the finished modified Hero Jr. stroboscope wheel:

MODIFIED HERO Jr Wheel:

Although the nylon wheel hub itself has very low friction running on the aluminium bush, it does pay to apply some grease to make sure it runs as smoothly as possible.

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