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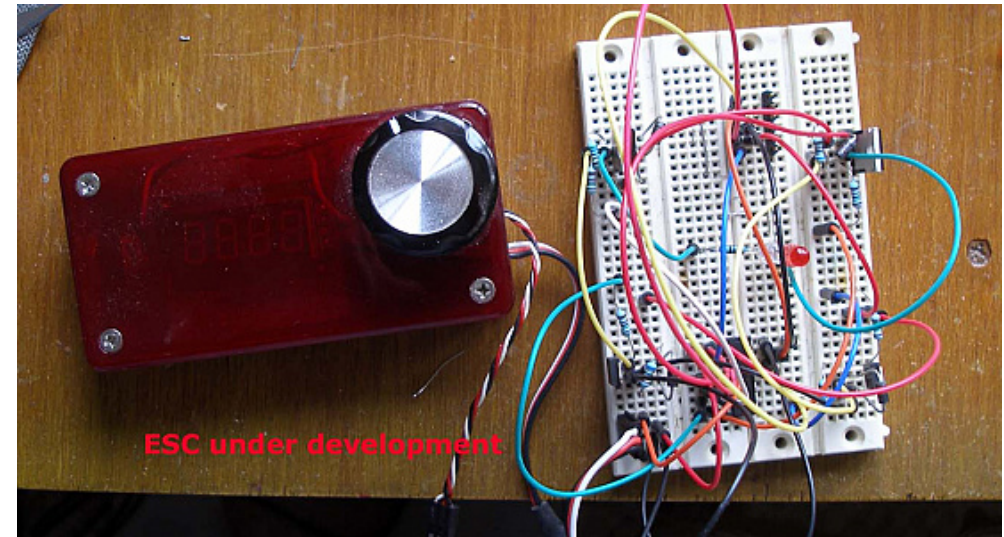
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## Micro Tug

by Graham93

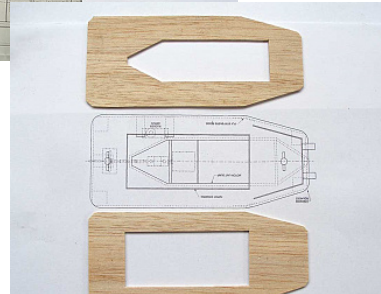
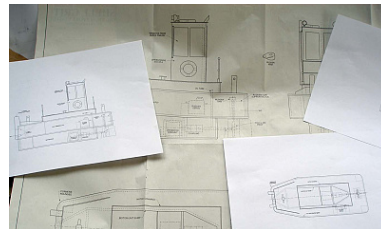


8th Apr 2020

## Micro Tug

Last week, after enduring a week of lockdown, I began to wonder when I would be able to get back to the boating lake. It is obviously going to be some time, so what is the alternative? The only water I have in the garden is the plaster mixing bath 'test tank', so could I build a boat to sail in that? Last night, here on the site discussion turned to similar thoughts:

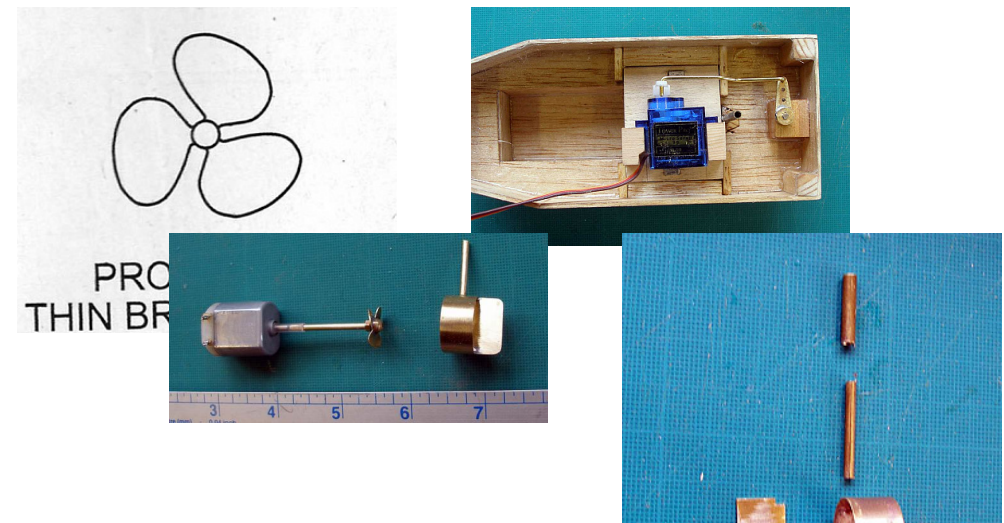
<https://model-boats.com/forum/69162#69493> But what to build? A recent copy of Model Boats included a free plan for a 'Pusher Tug'. I decided to have a go and see if I could build something based on the plan, with the added challenges of not buying any materials. Key parts of the plan were scanned using an A4 desktop scanner and then reduced in size to half the original scale using Photoshop. A couple of sections had to be scanned as two pieces, and then recombined in Photoshop. Once scaled down each part then fitted onto an A4 sheet and could be printed out. Collecting dust behind a bookcase in what used to be my sons' bedroom were some sheets of 1.5mm balsa. Ideal! After a few hours work, the basic hull was assembled using superglue. I haven't built anything in balsa since the 1980's with my sons. We used balsa cement in those days, but superglue makes it much quicker and easier. Graham93



8th Apr 2020

## Rudder, Prop, Propshaft and Motor

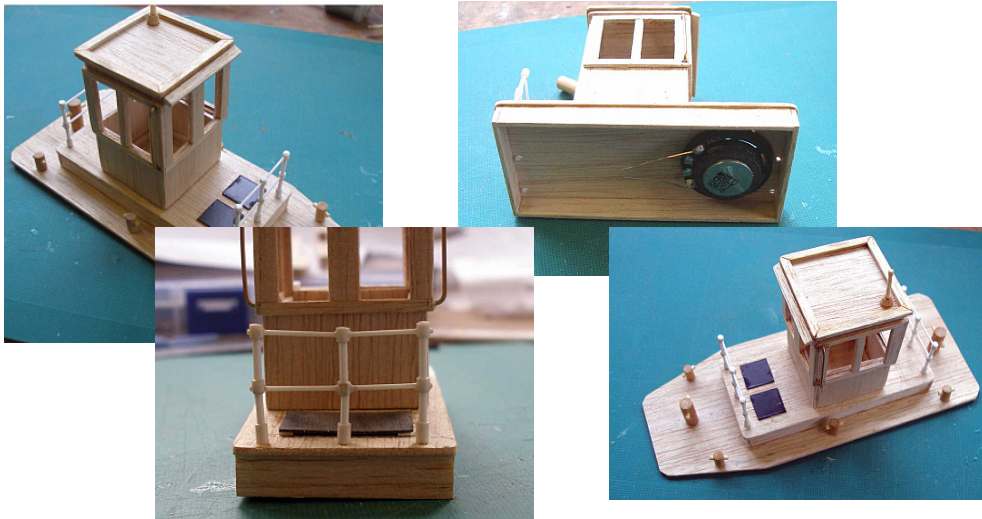
The rudder is made from 0.5mm brass sheet. A 10mm strip was cut and then formed into a ring approximately 19mm diameter. The ends were silver soldered together and then the ring was formed into a round kort nozzle using a mandrel. The rudder blade and brass rudder post were then added. The prop was also cut from 0.5mm brass using a template copied from the other free plan in the same issue of Model Boats. It is 15mm dia. Because of the arrangement of the prop inside the kort nozzle, the prop has to be threaded onto the end of the prop shaft. It would have been much easier to simply solder the prop onto the end of the shaft, but then it would have been impossible to assemble the completed rudder and prop into the hull. A small brass boss was turned with a 2mm threaded hole and the prop was soldered to it before the blades were gently twisted to give the prop some shape. The propshaft is 2.3mm brass rod, threaded 2mm to fit to the prop. The other end was filed to a square profile and coupled to the motor with a short length of ballpoint pen inner. The motor is from the salvage box. Not sure of it's origin, but probably salvaged from a defunct printer. The propshaft runs in a brass tube with no bearings (too small!) An oiler tube will allow the tube to be filled with oil and hopefully prevent water ingress as both ends of the propshaft are below water level. The smallest servo I had available is a basic 9g model. This is too big to fit upright in the hull so it is mounted horizontally on a plywood carrier. The carrier is held in place in the hull with magnets as it sits over the motor and needs to be removable to gain access to the motor. The photo shows the arrangement, before the hull deck is glued in place. Graham93



9th Apr 2020

## Deck fittings and Horn

For the handrails I didn't have any stanchions available so I ended up making them out of plastic rod and tube. It would have been much easier to use commercial stanchions?. The bollards are made from dowel and cocktail sticks. The horn on the wheelhouse roof was carved from dowel, and the aerial carved from a cocktail stick. The windows in the wheelhouse are cut out and will be glazed. To add some extra interest I decided to add a working horn. I found a small waterproof speaker in my salvage box, no idea where it came from (It pays not to throw anything away!) This is installed below the deck. The hole in the deck is covered with a piece of plasticard mounted on spacers to let the sound out. The speaker will be driven with a square wave oscillator controlled from a receiver channel. Graham93

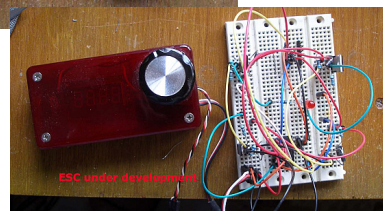
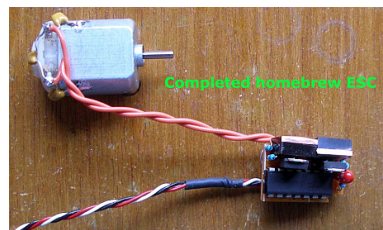
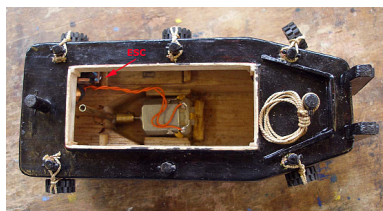




27th Apr 2020

## We are sailing.....!!

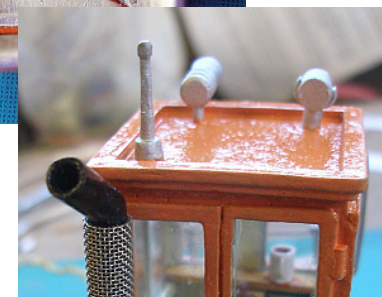
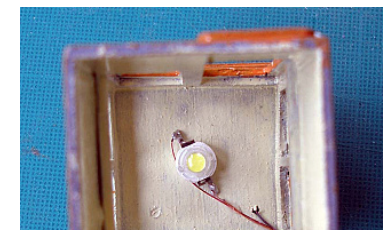
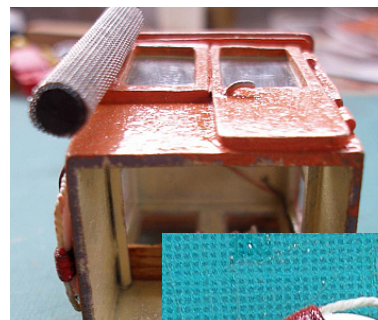
The motor was recycled, probably out of an old printer. On a four cell NiMH battery it ran OK, if a bit slowly. With the lack of movement of the boat I decided to investigate further. There are no markings on the motor case, but testing it on an adjustable bench power supply it worked a lot better on 12v than it did on 5v without overheating, so its time for a replacement. I was trying to build this tug from items I had in stock during lockdown without having to buy anything, but I didn't have another motor available that would fit in the tug. I managed to buy a replacement with an identical case size, and with a working voltage of 3.5 - 6v. This runs a lot faster than the original motor on the four cell battery. With the motor running faster, another problem became apparent. The ballpen inner tube coupling was stiff, and not very straight so there was a significant loss of power with lots of vibration. A replacement one piece propshaft and coupling were turned on the mini lathe. Whilst this is a rigid drive, at least it is straight. The motor is loose mounted in the tug so it can move a little while running. It all seemed to work fine on the bench so back to the plasterer's bath to test it for real. Just a few seconds of successful operation with the tug moving reasonably on the water before everything stopped. Back to the bench to investigate. The new motor draws a lot more current, especially with the tug in the water and the prop under load. This had fried the ESC. The ESC was recycled electronics from old servo. Looking up some old datasheets, the drive chip (NE543) was rated around 450mA. The new motor draws 200mA unloaded but this increases to 700mA when stalled. Trying to keep to the 'build it without buying anything' challenge I had set myself I decided to build a replacement ESC rather than buy one. The replacement is built out of 'bits I had in the box'. The output transistors are rated at more than 10A which is totally overkill, but they are what I had available. It works OK and the tug is now controllable, although a little difficult to sail in the bath. So in the end, I wasn't quite successful with the 'build it without buying anything' challenge as I had to buy a battery and a motor, but I had great fun trying and it certainly helped keep me occupied during this seemingly never ending lockdown.



10th Apr 2020

## Painting and Wheelhouse

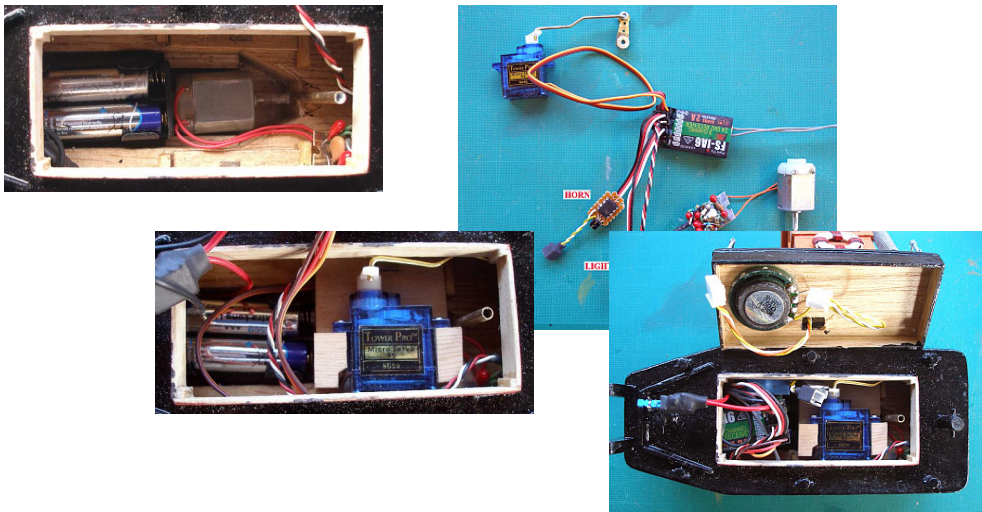
To strengthen and waterproof the hull it was painted inside with epoxy resin, before the deck was glued on. The outside of the hull was sealed with fibreglass and epoxy resin. With hindsight, using fibreglass cloth was a mistake. Difficult to apply and finish in such a small size. I should have used epoxy resin without the glasscloth. The end result is a rough finish which looks a mess. Not to worry though, this is just a bit of fun to relieve the boredom. The hull was then painted with red primer and black gloss rattle cans left over from the Crash Tender refit. The wheelhouse was painted inside and out using Humbrol enamel and then the windows were fitted. The wheelhouse is fitted with a spotlight on the roof, and an internal cabin light. Enamel copper wire was used for the connections down to the foot of the wheelhouse where a small piece of circuit board, hidden behind the engine control panel is used to attach standard wiring. The ships wheel was carved from 2mm plasticard and painted to resemble mahogany. The lifebelt was also carved from 2mm plasticard with thin cord added and painted for detail. The exhaust is made from black painted dowel wrapped with some fine stainless mesh I happened to have lying around. Quite by chance, a lego figure is the right size to act as skipper ?. He even has a large mug of tea to keep him going?  
Graham93



11th Apr 2020

## Controls

It was all going so well! Two RC switches were built to control the lights and the horn. Then came the time to install everything into the hull. It is very tight getting everything in through the deck hatch. First the motor and ESC followed by the battery, both fitted in the sump. The battery is the one item I didn't have available 'off the shelf'. I have ordered a NiMh 4 cell 2/3 AAA battery, but it has not arrived yet. As an interim solution, I fitted four AAA alkaline cells in a holder. It just fits, but is a bit heavy. Next the servo is maneuvered into place above the motor and the push rod attached. Finally the two RC switches and the receiver are squeezed into the remaining space above the battery and the horn and lights are plugged in. Disaster!! The top deck and wheelhouse don't fit?? The speaker on the underside of the top deck fouls the connectors plugged into the receiver. Several attempts to reposition the receiver in the hull are to no avail. No matter how I try to reposition the components, it cannot be assembled to leave enough room to fit the top deck on. The new battery, when it eventually arrives will be a bit smaller (and lighter) but I don't think it is going to solve the problem. I could remove the horn as it would then fit, but I don't really want to give up on that. Time for a rethink..... Graham93



21st Apr 2020

## Revised Controls

While waiting for the smaller battery to arrive, I decided to replace the iA6 receiver with Rx2A receiver to save more space inside the hull. The horn sound generator was modified by adding more connections and some additional software to decode the PPM output from the Rx2A to provide separate channels for the ESC, rudder and light switch. With these changes, and the new battery, everything now fits in the hull ?. It is a squeeze to get it all in, but it fits. The boat was completed with the addition of tyres along either side, courtesy of Lego. The video should have included the sound of the horn, but for some unexplained reason, the camera didn't record it. I'll have to investigate. Time for the maiden voyage ? Would it float or sink? With the hull so tightly packed, it is quite heavy for its size. The good news is, it does float. The bad news is that it doesn't really move ?. The best description I can give is that it 'drifts' with just a tiny influence from the propeller. The wind has more impact than the prop! Everything was dismantled and the propeller pitch increased by twisting the blades. A second trial showed a slight improvement. More work to do..... Graham93

