

# THE HATTON SLIP BOX

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AN INTRIGUINGLY DESIGNED GEARBOX WHICH NOT ONLY GIVES FORWARD AND REVERSE BUT CAN ADJUST THE SPEED OF A BOAT

If, like me, you enjoy tinkering with internal combustion engines, rather than electric motors, you have probably looked around the Internet for a simple model marine gearbox. There have been one or two produced but at a high cost, reflecting their mechanical complexity in using miniature gears as per full size practice. In this article we outline a really simple method of providing a clutch action with forward and reverse. If you construct scale models, building one will be well within your capabilities.

## HOW THIS INNOVATION CAME ABOUT

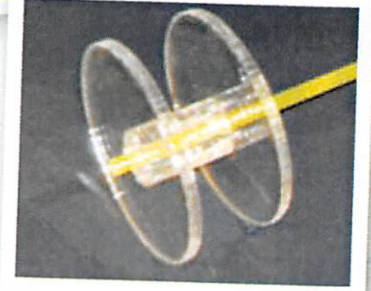
The idea for the Slip Box arose out of a school project looking at Subsistence Fishing. At Sir Christopher Hatton Academy in Wellingborough, pupils follow one lesson every week called Enrichment. This allows them to choose an activity from a range of Sports, Hobbies or Interests outside their normal learning experience. In Design Technology a series of these sessions was held promoting Engineering and Invention.

Students were encouraged to think about several problems including, Flood Prevention, Sea Water Desalination and Third World Subsistence Fishing. Some excellent ideas were created and the Slip Box is one of them.

Beginning as a simple exercise in the design of a coastal or river fishing boat for easy local construction, the research then began to include methods of powering it cheaply. We looked at sails or oars versus motors. On seeing the 'scaffold pole' motorised skiffs in places like the Mekong, the question of why outboards were not used raised issues such as cost and suitability of inboard motors with gearboxes. Our goal became to produce a full sized gearbox linked to a cheap single cylinder industrial engine. Then the idea took hold and a method of providing forward, neutral and reverse was evolved. The layout of our principle is shown in the three photos of the industrial motor and two discs, the arrows indicate rotation of the prop shaft changing whilst the motor crankshaft

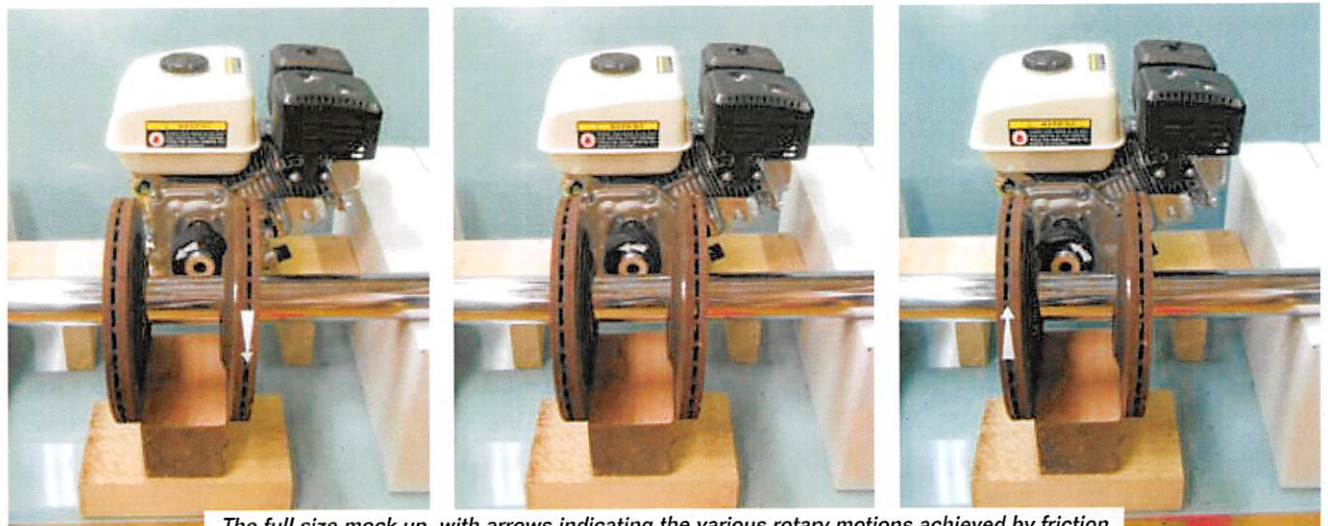


ABOVE: The Year Team with various hull designs

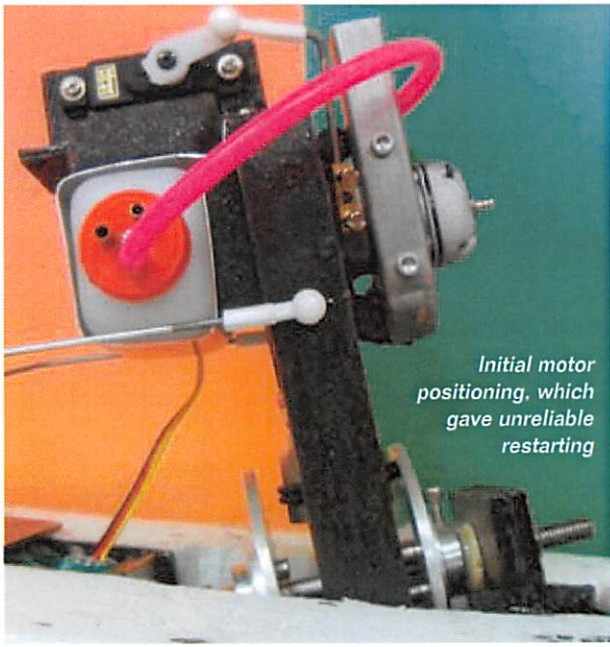


ABOVE: The heart of the system. Prototype laser cut trial model

maintains its' direction. A search on the Internet has not produced anything like it, if it does exist already it cannot still be the subject of patent. We have recorded an application so that no one can seize it commercially except without protection, making it available to all.



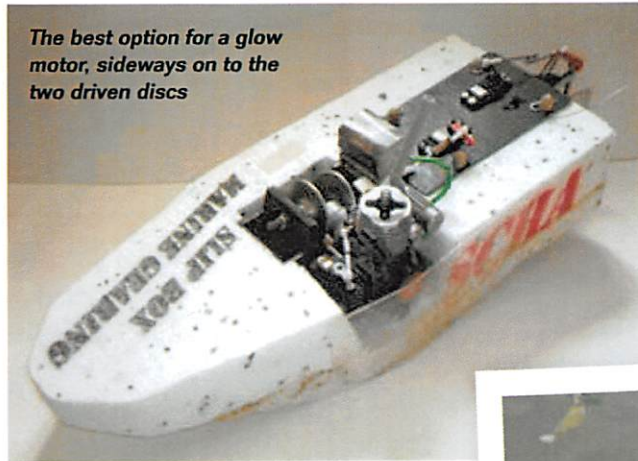
The full size mock up, with arrows indicating the various rotary motions achieved by friction



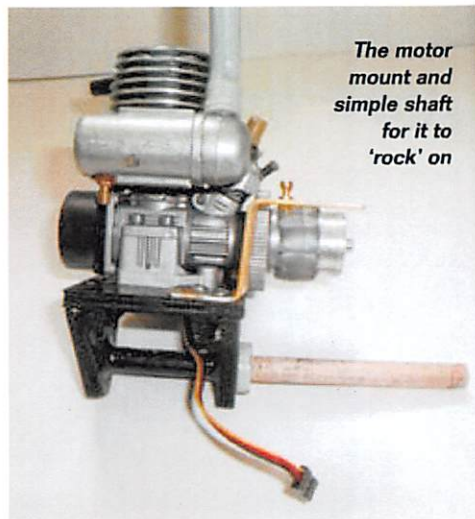
*Initial motor positioning, which gave unreliable restarting*

### THE RADIO CONTROLLED PROTOTYPE

The next step was to make a working radio controlled model. The prototype model's transmission works so well, that it is described here for you to consider as a possible means of powering your next scale model. The theory was tried initially using an electric motor for convenient running indoors. This showed that the principle worked, even though an electric motor could be reversed simply by changing the polarity of the supply.



*The best option for a glow motor, sideways on to the two driven discs*



*The motor mount and simple shaft for it to 'rock' on*

The next step was to try a model glow motor. This was mounted above the centre line with the crankshaft vertical and the front of the motor pointing down. This was done for no other reason than to keep the weight of the motor on the centre line. Starting was difficult without a pull start on the rear of the crankcase. A new model car motor with a pull start fitted and equipped with a fan cooled flywheel was obtained and again fitted nose down, with the crankshaft vertical and carburettor facing down. This was easy to start the first time and proved the gearbox works well. However, once warm it would refuse all attempts to restart it. This held up progress in photographing the boat running, and submitting this article, by a considerable time.

When we sat down to consider the problem it became clear that, while a helicopter motor is happy to run reliably with its' crankshaft facing vertically up, this was not so when the motor faced down. It seems that the warm residual oil, which on stopping the motor, would flow to the lowest point in the crankcase. In facing the motor down the oil was making its way straight into the carburettor. This was then sucked into the cylinder on the next attempted start and quenched the glow plug. We learnt a lot from this for helicopter modelling, but little use for our full sized application.

A full sized four-stroke, diesel or petrol, industrial motor has an oil sump and must remain fairly upright and would require fitting to the side of the drive discs. So a quick rebuild was required to reposition the motor to more like our envisaged full size layout. Rocking the motor by a small amount, effects the clutch action, and is so small it is not outside normal operating conditions of these types of motor. The realigned model motor now works perfectly and starts easily hot or cold.

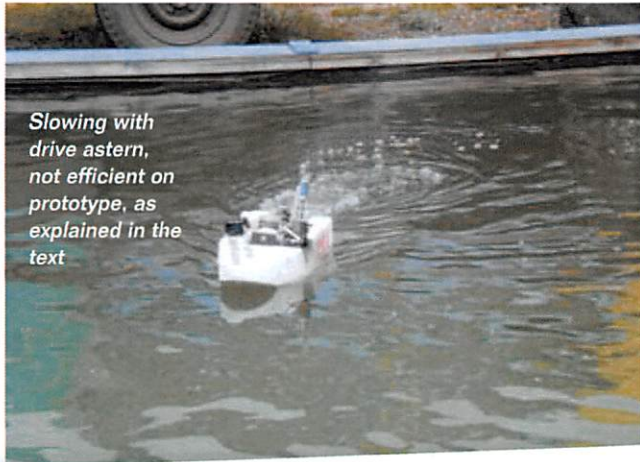
### TRANSMITTER FUNCTIONS

The forward and reverse action on our test model's transmitter is set to what would usually be elevator on the right stick in mode two on an aircraft set. The rudder is set as the right sticks' horizontal movement. The throttle is the fore and aft movement of the left stick. Forward and reverse are adjusted via the transmitter trimming so that the pressure exerted by the servo is limited to 'just enough'. This avoids draining the receiver battery from continual over control of the servo motor. The lever still has its centring springing, so hands off puts the boat into neutral.

So in conclusion, we have a fully controllable system which provides forward and reverse with a centre neutral position. Giving you the opportunity, if you are so inclined, to use Glow, Diesel or Petrol power in a scale model.



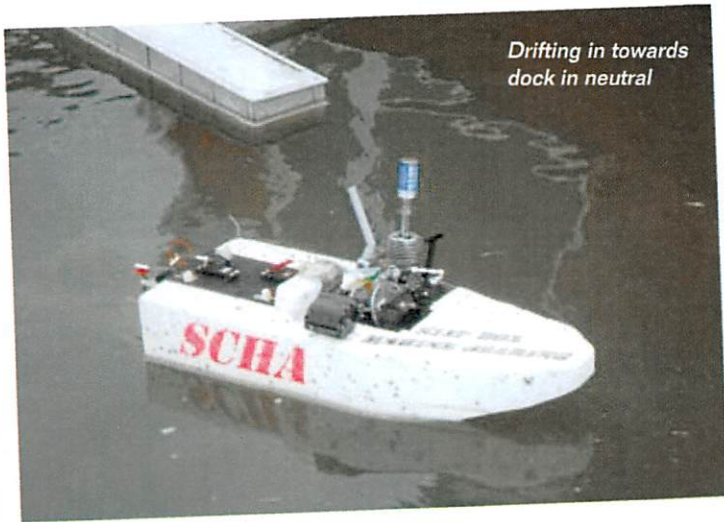
*The 'Slip Box' driving ahead slow. Yes we did forget the glow plug driver!*



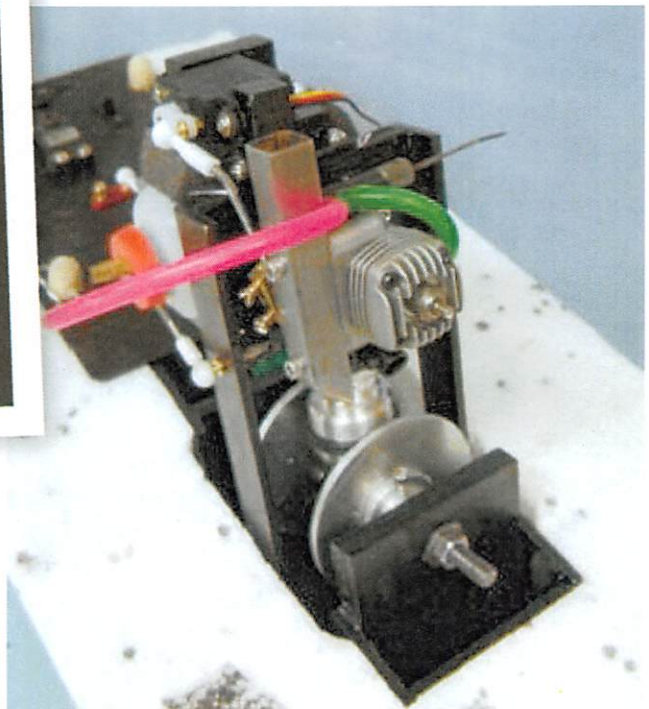
*Slowing with drive astern, not efficient on prototype, as explained in the text*



*The wash from the prop in astern hits the transom virtually dispersing the thrust. We will have to redesign this*



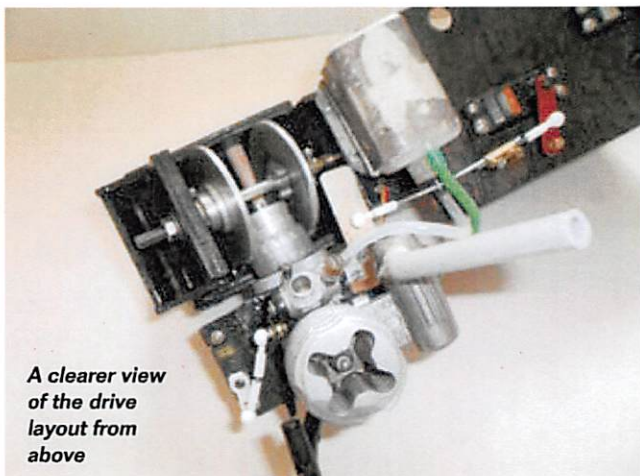
*Drifting in towards dock in neutral*



*The first prototype which clearly shows the principle, but was difficult to start*

#### LAYOUT AND MAKING OF THE SLIP BOX

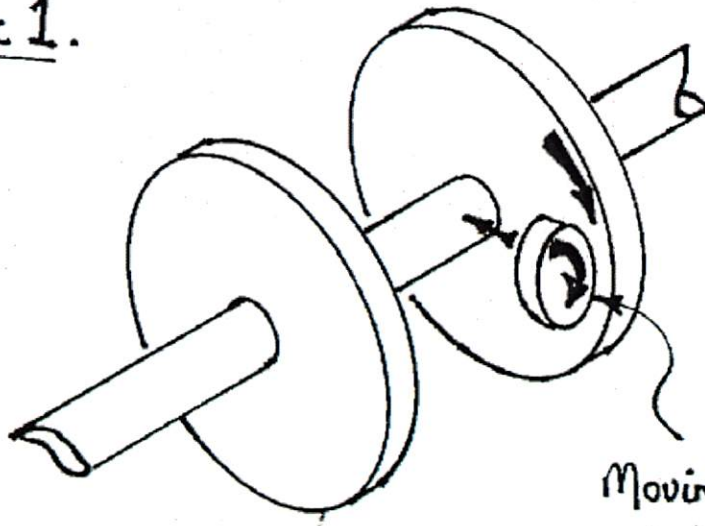
The general layout of our prototype allows the students various boat designs, from the original project, to be tested. This meant that the radio system and motor unit fits into a pod which slots into each boat, keeping costs down. Although the designs were proposed to be constructed from plywood, cutting them from Styrofoam was a quick and simple method of testing boat shapes. This raised a problem, due to the angle of the prop shaft and the blunt stern, the flow from the prop in reverse hits the pod stern and negates a lot of the thrust in reverse. We won't be doing this on our final full sized design.



*A clearer view of the drive layout from above*

As you have seen previously, the three pictures of the full size layout show the three motive states: forward, neutral and reverse. The engine mount does not need to rock or swing very far to allow the drive to engage and disengage. A fairly powerful servo is fitted to move the motor mount and it requires careful trimming to allow enough pressure to transfer drive, but not enough to raise the current drawn by the servo from the battery. There is a section of silicon silencer tubing pressed onto the flywheel, this transfers the drive friction to one or the other of the two aluminium drive discs. Alternatively a solid rubber tyre could be fitted tightly into a machined groove to affect the same friction drive. The discs were simply cut by junior hack saw and then filed by hand into shape. Suitable aluminium and stainless steel discs can also be sourced ready cut from various suppliers on eBay. The prop shaft has been extended, with an additional bearing aligned at the forward end, to provide support for the two discs.

## Graphic 1.



BELOW: Sir Christopher Hatton  
Academy Ofsted inspection,  
January 2015. 'Outstanding'



Moving drive wheel  
towards centre  
increases output  
R.P.M.

### FURTHER REFINEMENTS

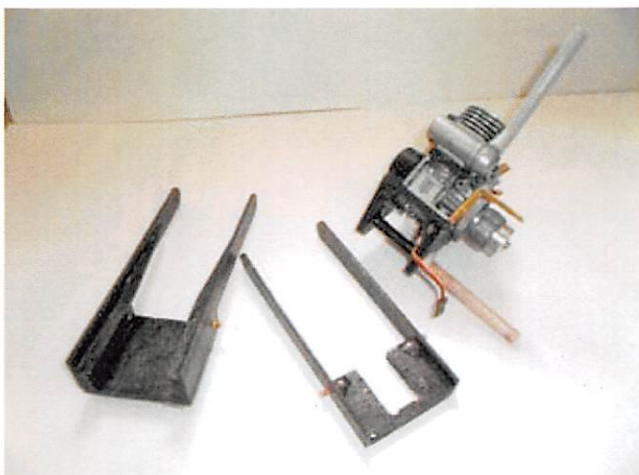
The ratio of the input to the output revolutions can be varied by the positioning of the motor drive wheel at its point of contact on the discs. Moving the wheel in towards the centre of the disc will raise the output revolutions. Positioning it towards the outer diameter of the discs will lower the output revolutions. Further refinement could be achieved by fitting another servo to control this. There is also the possibility of powering the system with a simple internal combustion motor, without a variable throttle. By letting the drive slip more than when a radio controlled throttle is fitted, you have the ability to control the speed the boat runs at.

The engine mount could be fitted onto linear tracks and slide fore and aft. There is a range of linear polymer bearings available which can glide, almost without any friction, along round chromed bars.

Your choice of motor is not limited to glow plug or petrol engines. This method of control would also be suited to the use of a 'turbo prop' type of gas turbine engine. Although there is the incongruity of a very expensive engine and a very simple and cheap transmission control to consider! However, a large aircraft carrier with a gas turbine exhausting into its funnel would be very impressive.

### THE FULL SIZED DESIGN DESCRIBED

The three earlier photos of the full sized mock up show clearly how forward, neutral and reverse are selected. These discs can either be made for purpose or be reclaimed scrap vehicle brake discs as shown. The crankshaft drive wheel itself has a two part boss fitted,



Engine mounting development

into which are clamped the stamped out rubber discs cut from scrap tyre sidewalls. Spares of these can be produced very cheaply and therefore wear should not be a major consideration. Industrial motors are usually fitted with strong output bearings intended for belt or chain drive and are able to stand considerable size loads. Cooling the engine would not be a problem as industrial motors usually have a forced air fan built in. They also come fitted with a recoil hand start system and the larger types with electric starters. The main problem will be ensuring that the exhaust gases do not affect the occupants of the boat. A tall insulated tractor type exhaust would send the fumes safely up and away from the boat. The total package would be much cheaper than a proprietary outboard motor and the various parts should be easily available locally.

For further consideration, we also thought about a tug boat (full sized or model) fitted with twin engines and slip boxes which could produce a highly manoeuvrable craft. By selecting forward drive on one side and reverse on the other, it could spin on its axis and turn in its own length.

We are intending that our initial patent application will not be followed through, so that information on this innovation can be published and filter into the open. It will then be available for subsistence fishermen to use in their boats. Hopefully it will stop exclusive use in a commercial setting and allow units to be built and sold for the general good of less wealthy communities in the third world. We hope to construct and run a website which users could refer to and post their project pictures.

The Hatton Academy team, students in year 8, Andrew Harrison, Bleq Johnson, Zak Rogers, Sergio Rodriguez Escoto, Antony Stevenson and Louis Walters. Staff, Steven Lane and Neville Marsh.

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