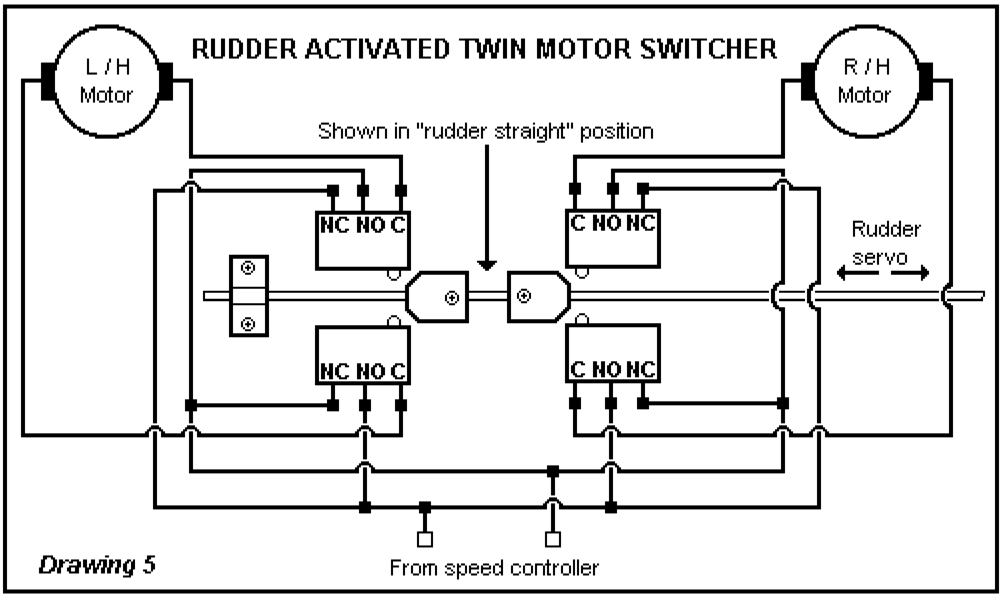
ROUND THE BEND

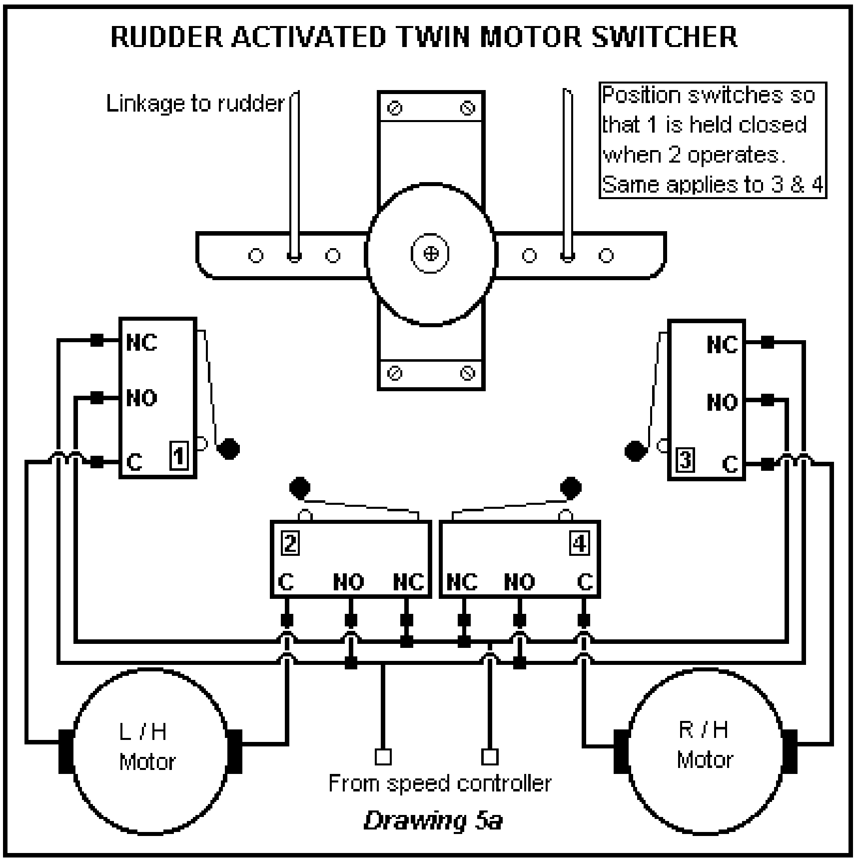


Drawing 5

A guide to switching twin-motored boats from the rudder by micro switches and without the added expense of mixers.

Drawing 5 shows the general wiring layout for use with a push rod actuated switcher and is really self-explanatory.

Drawing 5a is the method I prefer to use. An extension on both sides of the rudder servo arm switches the motors. I find this an easier set up, once the switches have been correctly positioned. The only disadvantage being it is non-adjustable



Drawing 5a

STEP 1

Make an arm extension so that it fits under and to the servo cam but allows the servo to operate without binding. A couple of ice-lolly sticks glued together or whatever else comes to hand will do. After fixing extension make sure that the rudder linkage holes on the servo arm are clear.

STEP 2

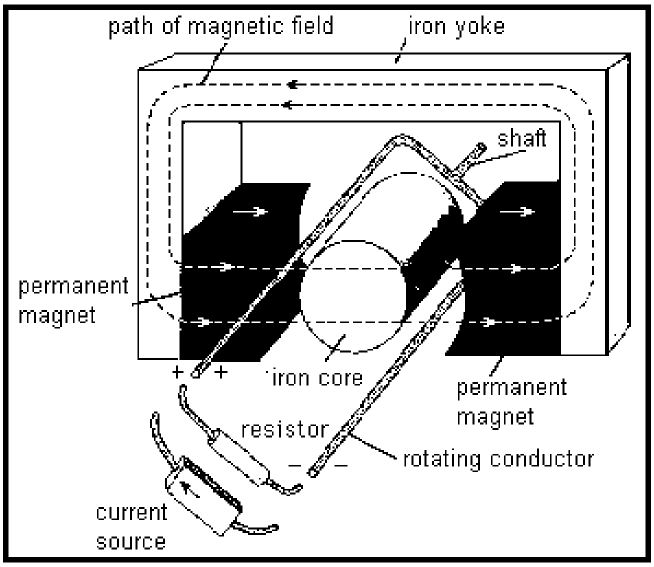
Manufacture a base for the switches and mount as close to the steering servo as possible, allowing the extension arm to pass just over the top. Set the rudder at half and switch off receiver. Position first switch so that contact is just made and the switch operates. Screw the switch to the baseboard. Reset rudder at full and repeat with second switch, making sure that the extension arm is holding the first switch open. Exactly the same procedure applies for the other side. Test to make sure that extension arm is actuating the switches correctly. I find that by using either roller or lever micro switches it makes it a lot easier to position them correctly.

STEP 3

Wire up the switches making sure that no wires are touching that shouldn't be. Connect motors and speed controller and test. If all is correct when the rudder is at half left the left prop should stop and with the rudder at full left the prop should then reverse. You might have to reverse the wiring connectors on the motors or speed controller to get the desired prop rotation.

If set up correctly your boat when on the water should now turn on it's own axis when full rudder is applied and turn sharper at half rudder. You should also be able to steer astern regardless of hull shape. The wiring may look a bit messy but it isn't seen so it doesn't really matter. You could try using copper-backed circuit board for the base but I didn't have a lot of success with it when I tried. If you install this steering aid then you too can be round the bend just like me.

DIRECT CURRENT COMMUTATOR MOTORS



In an elementary form of a DC motor, a stationary magnetic field is produced across the rotor by poles on the stator. These poles may be encircled by field coils carrying direct current, or they may contain permanent magnets. The rotor or armature consists of an iron core with a coil accommodated in slots. The ends of the coil are connected to the bars of a commutator switch mounted on the rotor shaft. Stationary graphite brushes lead to external terminals.

Suppose a direct-current supply is connected to the armature terminals such that a current enters at the positive terminal. This current interacts with the magnetic flux to produce a counterclockwise torque, which in turn accelerates the rotor. When the rotor has turned about 120°, the commutator reverses the connection from the supply to the armature coil. The new direction of the current in the armature coil is such as to continue to produce counterclockwise torque. As the rotor rotates in a counterclockwise direction, a voltage proportional to the speed is generated in the armature coil. While this coil voltage is alternating, the commutator action produces a unidirectional voltage at the motor terminals with the polarity shown. The electrical input will be the product of this terminal voltage and the input current. The mechanical output power will be the product of the rotor torque and speed.

In a practical DC motor, the armature winding consists of a number of coils in slots, each spanning $1/p$ of the rotor periphery for p poles. In small motors the number of coils may be as low as three, while in large motors it may be as large as 300. The coils are all connected in series, and each junction is connected to a commutator bar. If current enters at the positive brush, the coil currents have the directions shown. All coils under the poles contribute to torque production.

A typical small DC motor, such as those used in automobile fans, contains two poles made of ferrite permanent-magnet material. When higher torque is required, as, for example, in the starter motor of an automobile, stronger magnets such as neodymium-iron-boron may be employed. When the terminals of this motor are connected to a constant direct-voltage source, such as a battery, only the resistance of the armature winding and the brushes will limit the initial current. The torque produced by the interaction of this current with the field accelerates the rotor. A voltage is generated in the winding proportional to the speed. This voltage opposes that of the source, thus reducing the current and the torque. With no mechanical load, the generated voltage will rise to a value nearly equal to the source voltage, allowing just enough current to provide for friction torque. Application of a load torque slows down the rotor, decreasing the generated voltage, increasing the current, and producing torque to match the load torque.

With larger motors, the armature winding resistance is too low to limit the current on starting to a value that can be switched by the commutator. These motors are normally started with a resistance connected in series to the armature supply. This resistance is usually decreased in stages as the speed increases.

Some types of permanent-magnet commutator motors have no provision for speed control when attached to a constant-voltage supply. If speed adjustment is desired, iron poles with field coils can replace the permanent-magnet field. These coils can be provided with current from the same supply as for the armature or from a separate supply. A variable series resistor can be used to adjust the field current. With maximum field current and thus maximum magnetic flux, the generated voltage will equal the supply voltage at a minimum value of no-load speed. As load is added, the speed will reduce somewhat and the armature current will increase to produce the required torque. If the field current is reduced, the motor will have to rotate faster through the reduced flux to generate the same voltage. The no-load speed will be increased. For a given rated armature current, the available torque will be reduced because of the reduced flux. The motor, however, will be able to provide the same mechanical power at a higher speed and lower torque.

Commutator motors with adjustable field current are known as shunt motors, or separately excited motors. Normally, the available speed range is less than 2 to 1, but special motors can provide a speed range of up to 10 to 1.
Another form of commutator motor is the series motor in which the field coils, with relatively few turns, carry the same current, as does the armature. With a high value of current, the flux is high, making the torque high and the speed low. As the current is reduced, the torque is reduced and the speed increases. In the past, such motors were widely used in electric transportation vehicles, such as subway trains and forklift trucks.

Large DC motors usually have four or more poles to reduce the thickness of the required iron in the stator yoke and to reduce the length of the end connections on the armature coils. These motors may also have additional small poles, or interpoles, placed between the main poles and have coils carrying the supply current. These poles are placed so as to generate a small voltage in each armature coil as the commutator shorts it out. This assists the quick reversal of current in the coil and prevents commutator sparking.

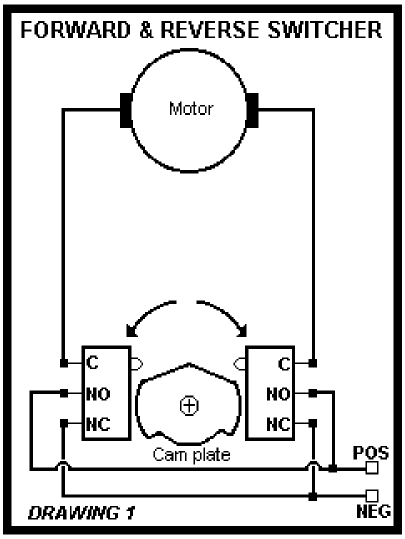
DC commutator motors have been extensively used in steel mills, paper mills, robots, and machine tools where accurate control of speed or speed reversal, or both, are required. The field is supplied from a separate voltage source, usually with constant field current, or from permanent magnets. The armature is supplied from a source of controllable voltage. The speed is then approximately proportional to the source voltage. Reversal of the armature supply voltage at a controlled rate reverses the motor.

A useless bit of information is that a dynamo is an electric motor in reverse i.e. if the iron core and windings are rotated in a magnetic field current is produced at the commutator in direct proportion to the rpm of the core.

ARE YOU TURNED ON

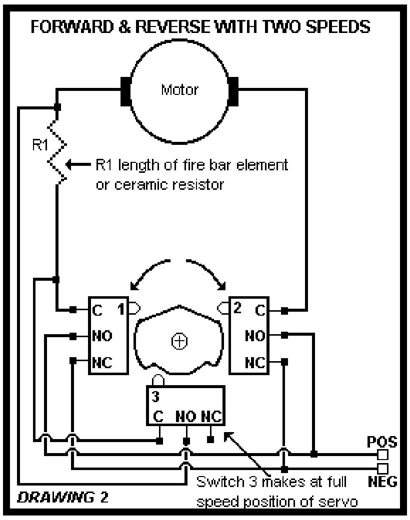
For most people to get turned on requires only a few basic ingredients, such as a latex rubber suit, baby oil, handcuffs and a couple of electrodes. Whoops! Sorry wrong subject.

We can all now buy electronic switchers, relays and a host of other expensive add-ons, but the humble micro switch is fairly basic, versatile and certainly cheap. The following are just a few easy to build and cost effective switching circuits, which can be incorporated in your models.



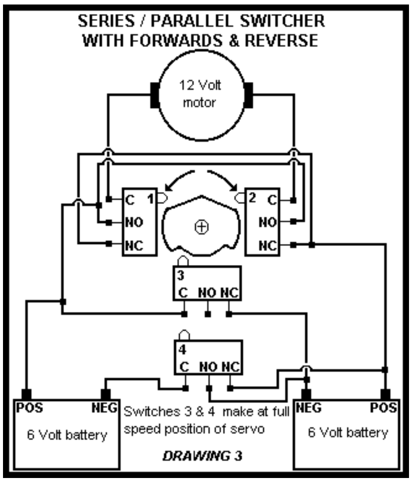
A FORWARD & REVERSE SWITCHER

Drawing 1 The switches are mounted on a board of suitable material, which sits on top of the servo similar to the fixing of a Bob's board. The cam plate can be made from plastic, Tufnol or even a round servo horn with appropriate cut-outs. The two micro switches are mounted so that when the servo turns from the centre position one of the switches is made to operate. At rest you will see that both motor leads are connected to the negative line but when one or the other switch is made the lead is connected to the positive line and the motor turns in the desired direction. If you use a servo horn for the cam plate this could be connected to the rudder and the motor to a bow or stern thruster in which case the additional servo wouldn't be needed.



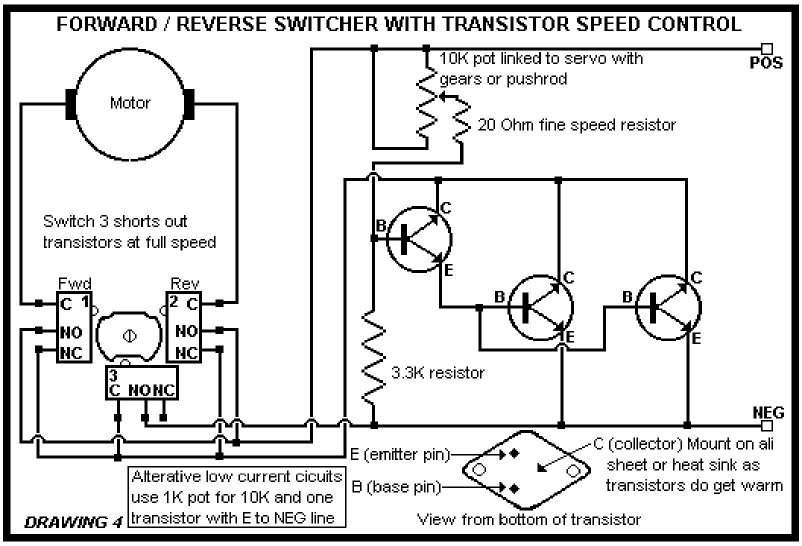
A FORWARD & REVERSE SWITCHER WITH 2 SPEEDS

Drawing 2 Drawing two is nearly the same as drawing one but with the addition of a resistor R1. This could be a short length of fire bar element or a ceramic resistor, whichever comes to hand. The rating of resistance can be adjusted by the length of element used until the desired speed reduction is achieved. The micro switch 3 is connected across the R1 and shorts out the resistance when the servo reaches the full speed position. On most boats full speed going astern is not required so the cam plate can be cut away so that switch 3 does not operate when going backwards.



A SERIES & PARALLEL SWITCHER WITH FORWARD & REVERSE

Drawing 3 This set-up is very useful if you a are running a 12 volt motor and have two 6 volt batteries and want to supply the motor with 6 volts for reduced speed and 12 volts for full speed. The cam plate is the same as the previous drawing but switches 3 and 4 operate together. When the forward or reverse switch is just made the two batteries are connected in parallel and supply 6 volts to the motor. When the full speed position is reached in either direction the switches 3 and 4 operate and join the batteries in series and therefore supply 12 volts to the motor. Any voltage batteries can be used as long as both batteries are of the same voltage and capacity.

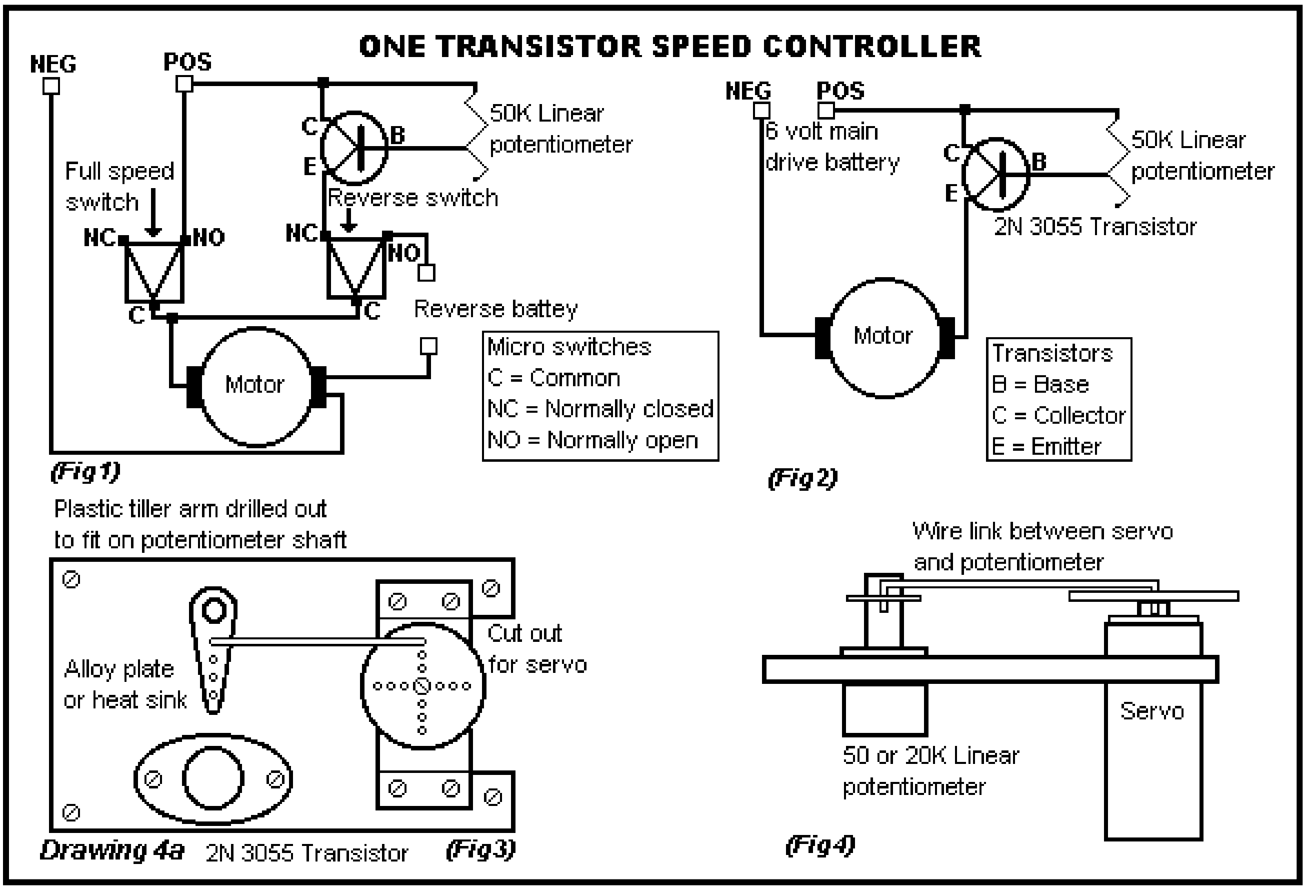


FORWARD & REVERSE WITH TRANSISTOR SPEED CONTROL

Drawing 4 A simple speed controller using a 10K pot, three or less 2N3055 transistors and some resistors. The 10K pot is driven by a separate servo linked either through gears or a rod. The forward and reverse switches work as in the previous circuits but switch on before the transistors for direction. The pot continues to turn as the servo turns and increases the speed of the motor. At full speed switch 3 makes and this shorts out the transistors putting full voltage to the motor. At full speed no power is going through the transistors so therefore they are not getting hot or absorbing any current. The 3.3K resistor is used to trim the slow speed but a smaller one can be used if so desired. It is recommended to mount the transistors on a metal plate to act as a heat sink. The C (collector) connections make contact with the plate which is wired to the NEG side of the circuit. A low current version can be made using only one transistor and a 1K pot but make sure that the power is switched off when not in use or you will flatten your batteries. These diagrams etc. were originally in Radio Control Boat Modeller in Nov/Dec 1985. You didn't think I was clever enough to draw these did you?

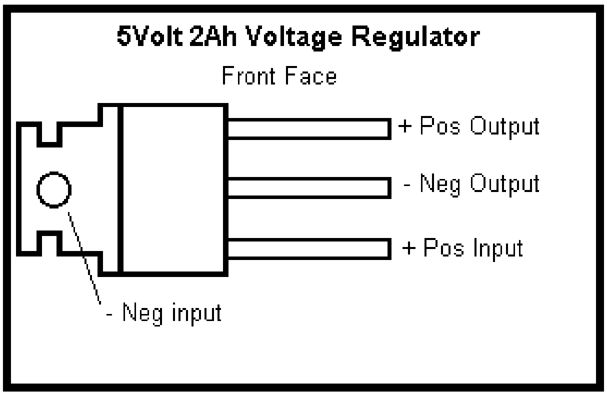
Back to the more interesting original subject. Spread a latex sheet over the bed, put on your rubber suits and apply a liberal quantity of baby oil to you, your partner and the sheet. Take the handcuffs (*to be continued).*

NOT EVEN A POT TO **** IN



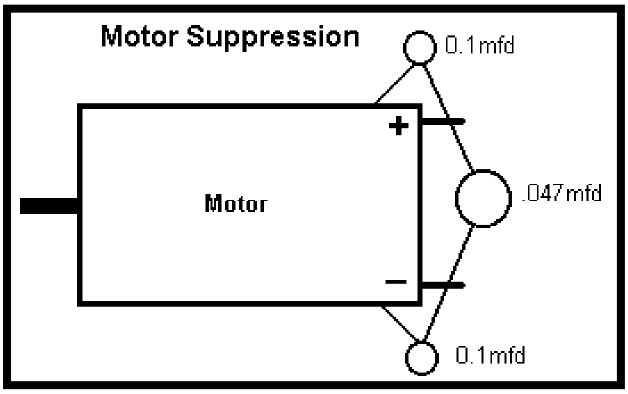
This is a one transistor; one potentiometer speed control circuit suitable for use with fairly low current drain applications. This speed control can be incorporated into some of the switchers shown in the last issue of the magazine. At least a full speed switch should be fitted, as the transistor will draw 1/2 to 1 volt from the system, thus reducing your speed at full forward transmitter control. Fig 1 shows a separate battery with a switch for reverse, this can be of a lower voltage to reduce speed going astern but can be eliminated if so desired. Fig 2 is just the plain speed control circuit, which will be constantly "live" so some form of switching should be fitted, otherwise flat batteries will be the result. Figures 3 and 4 are a mounting suggestion, which works. I have also seen the servo and potentiometer linked by gears and even a pulley system could be used. It is essential to mount the power transistor on an aluminium sheet or a heat sink of some sort as it does tend to become warm when in use. The 2N3055-power transistor is still available from Maplins or Squires for about 90p. The linear potentiometer can be of any value under 50K. The lower the value, the finer the speed control but too fine and you could burn out the pot. I should think that the whole set-up (excluding servo) should not cost more than a fiver and a little of your time.

BATTERY ELIMINATOR CIRCUIT



Speed controller kits with a BEC included can cost anything up to £5.00 extra to buy. A 5volt 2Ah-voltage regulator can be obtained from Maplins or Squires for about £1.25 thus saving you £3.75 or the true value of a Deans Marine kit. To use a voltage regulator the supply voltage must 7.2volts or over. Mount the regulator on a heat sink of some kind; connect the positive lead of your battery to the positive input of the regulator via a switch. The negative lead of your battery is connected to the negative input of the regulator. The positive and negative outputs are then wired into your connection for the battery input on the receiver. These voltage regulators will work with any voltage up-to and including 35 volts. It can of course be used to reduce the voltage on any application that requires only 5 volts to operate.

SUPPRESSING ELECTRIC MOTORS



I know some club members don't suppress their motors, but because a motor when turning is switching on and off at high speed RF spikes can occur which can effect the signal to the receiver, causing glitches to the servos etc. The ideal recommended procedure is to attach two 0.1mfd ceramic suppressers to the motor casing and terminals with a .047mfd in between the motor terminals and an earth wire from the motor casing to the prop shaft. I have found that usually just a .047mfd suppresser soldered between the motor terminals is sufficient. The choice is yours but if maximum range from the radio is required I strongly suggest that some form of motor suppression is fitted.

Keith Appleford.