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speed controller for motors

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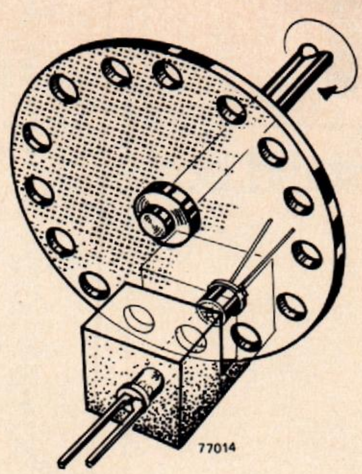
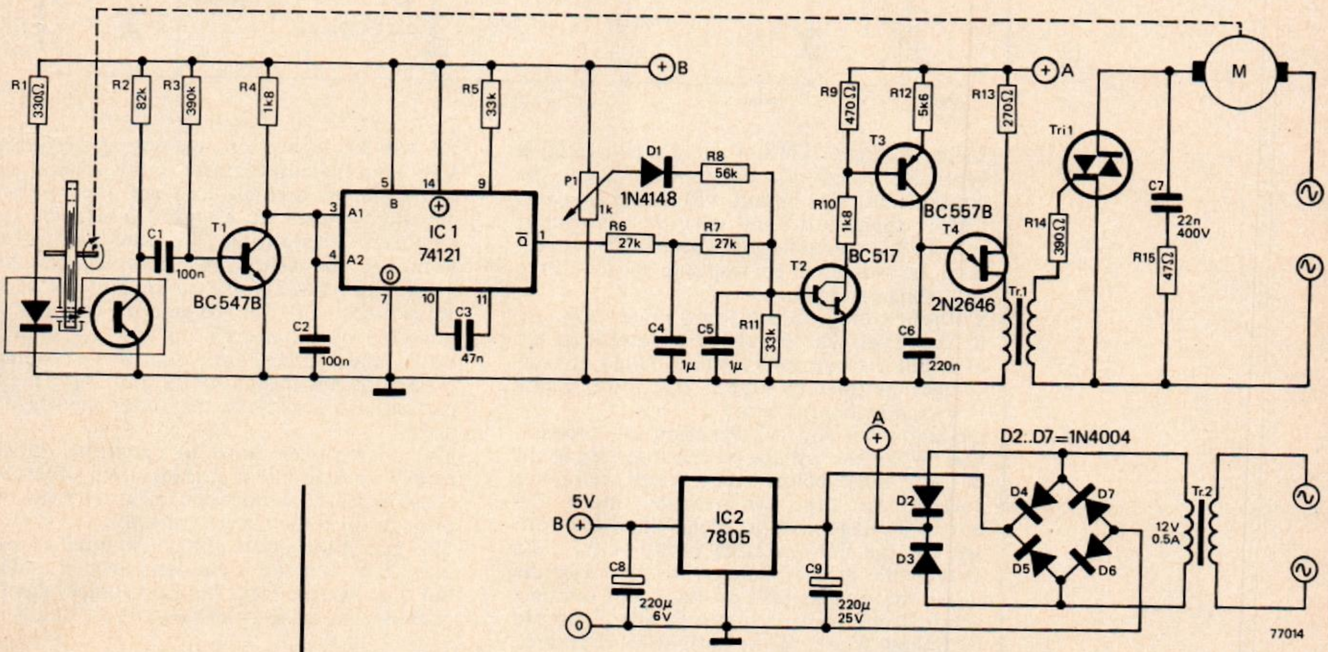
Electric motors up to around a quarter horsepower can often be picked up very cheaply (ex-domestic appliances). They are extremely useful for driving bench saws, drilling machines etc. A speed controller that will set and maintain a near-constant speed under varying load conditions is a useful accessory in this type of application.
The motor speed is sensed by an optical commutator consisting of a disc with 15 holes or slots around its periphery. This interrupts a light beam falling on a phototransistor, which turns T1 on and off. Pulses from the collector of T1 are used to trigger a monostable IC1 whose $\overline{Q}$ output is integrated by R6/C4 and R7/C5 to provide a DC output level which is inversely proportional to motor speed.
The desired motor speed is set by P1 and the





desired and actual motor speeds are compared by T2. T3 and T4 form a trigger pulse generator which produces a pulse to fire the triac once every half cycle of the mains waveform. T2 varies the collector current of T3 and hence the charging current of C6.
This in turn controls the point in the cycle at which the trigger pulse occurs.
If the motor speed should tend to rise then the voltage on C4 will fall and the base current of T2 will be reduced. The collector voltage of T2 will rise, thus reducing the current through T3, and the trigger pulse will occur later, causing the motor to slow down. If the motor tends to slow down the reverse will occur. The voltage on C4 will rise and the collector voltage of T2 will fall, thus increasing the collector current of T3 and causing the trigger pulse to occur earlier.
The trigger stage (T2 . . . T4) is driven from an unsmoothed full-wave rectified supply (A). When T4 fires, it will discharge C6 rapidly and then remain conducting until the supply voltage approaches the next zero-crossing. The result is that C6 is always discharged at the start of each half-cycle, so the position of the trigger pulses relative to the zero-crossings is determined solely by the current through T3. In other words, the trigger pulses are synchronised to the mains.
The type of triac required will obviously depend on the motor used. It should be rated for at least three times (!) the nominal mains voltage; the current will depend on the maximum motor current, and a reasonable rule-of-thumb is to divide the motor power rating by the mains voltage and multiply the result by two. As an example, a 500 W/245 V motor would require a triac rated at $\frac{500}{245} \times 2 \approx 4$ amps!
The trigger pulse transformer (Tr1) can be wound on a type AL250 potcore: primary 80 turns, secondary 40 turns, both 0.1 mm enamelled copper wire (42 S.W.G.).
Editorial note: In some cases it may be possible to dispense with the 'disc-with-holes'. If the LED and phototransistor are mounted inside the motor casing, the motor itself may sometimes be used to periodically interrupt (or reflect) the light beam.