M. Keul, H. Löhr

the moth

This is a design for a simple cybernetic model, based on an electric toy car, that will be attracted towards a light source like a moth, negotiating obstacles in its path.

The car has two motors, one to propel it and one for the steering mechanism.

The principle is quite simple. A light-sensitive element is mounted obliquely to the right at the front of the car.

Normally the steering motor keeps the car on a left turn, but this motor can be reversed by a relay, so that the car turns to the right. This happens each time the light-sensitive element receives light.

If the car, travelling to the left, passes a light source, it swerves to the right in the direction of the light. However, it keeps turning to the right, so that after some time the element receives no more light.

Then the car will automatically swerve to the left again until the element again receives light from the source, and so on. Thus the car zigzags towards the light source. It behaves more or less like a moth, hence the name of this apparatus.

The circuit

The light-sensitive element used here is an LDR placed in a cardboard tube. This tube must be about 3 ... 5 cm long to screen off the daylight. Via an amplifier consisting of T_1 and T_2 (figure 2), the LDR drives a relay Re_1 which reverses the steering motor M_1.

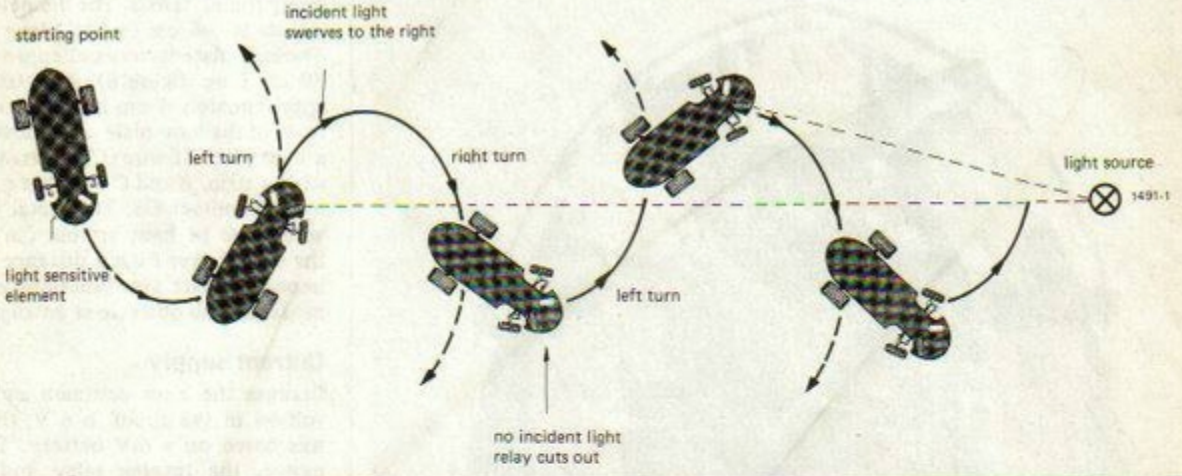
P_1 serves to adjust the sensitivity of the car. That is to say, it determines how far the car will swerve to the left or the right on its way to the light.

In this circuit the moth will hardly ever reach the light source because in a furnished room it will usually collide against a wall, chair, table or something else, and come to a standstill there. So it must be able to avoid an obstruction, an idea which is not so difficult to realize. For that purpose a mercury switch is fitted to the car chassis in such a manner that the contact just remains open. Now if the car collides, the mercury moves about in its tube with the result that the contact is closed momentarily (figure 3).

In the circuit diagram S_2 is the mercury switch. Via this switch C_1 is charged rapidly and then slowly discharges again. Thus the short pulse from the switch is artificially lengthened. As long as C_1 has a potential greater than 0.7 V, T_3 is turned on so that relay Re_2 is energized for a few seconds. This energizing time can be varied by means of P_2.

The second relay has two functions.

1



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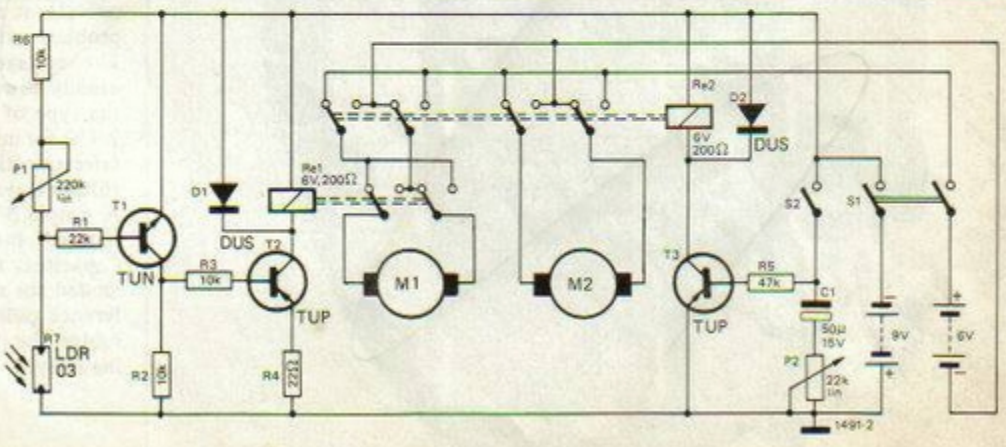


Parts list

Resistors:
R_1 = 22 k
R_2,R_3,R_6 = 10 k
R_4 = 22 Ω
R_5 = 47 k
R_7 = LDR 03, ORP12
P_1 = 220 k lin.
P_2 = 22 k lin.

Semiconductors:
T_1 = TUN
T_2 = TUP
D_1,D_2 = DUS

Miscellaneous:
M_1 = steering motor
M_2 = drive motor
S_1 = switch, 2 X make
S_2 = mercury switch
Re_1,Re_2 = relay 6 V, coil resistance about 200 ohms

Capacitors:
C_1 = 47µ/16 V

Firstly it reverses the drive motor so that the car backs away from the obstruction. That alone would, however, not be sufficient, for if the car were then to start forward again, it would hit the obstruction a second time, and so on.

It is, therefore, also necessary that when the car backs away, the steering wheel be turned in the opposite direction in order to avoid the obstruction. So the second function of Re_2 is to reverse the steering motor. Thus the motor is controlled in two ways: by the optical circuit (via Re_1) and by the mercury switch (via Re_2). Now the moth will always reach the light source, provided there is a road.

The mechanical part

Electric toy cars that can be remotely controlled by a cable make ideal basic material.

The authors used an old lorry; the drive motor remained as it was, and a smaller motor was mounted at the front. On the spindle to which originally the remote control wire was connected, a pulley from a construction kit was mounted; another pulley was mounted on the motor shaft. Then these two were connected with a rubber drive belt.

It was found that it is better to drive steering mechanism via a slipping clutch. If the motor engaged directly with the steering mechanism, it would remain stalled most of the time because the steering circuit is limited on both left and right.

As a result, current consumption would rise substantially. Figure 4 shows a home-made slipping clutch. Next to the wheel mounted on the steering spindle, a larger loose wheel is placed which is forced against the fixed wheel by a spring. First pieces of felt are glued to the contact faces of these wheels. The loose wheel is coupled to the motor and via friction of the felt between, it drives the bottom wheel and thus the steering circuit.

The supply

Owing to the high current consumption of the motors, it is recommended that they be driven from an accumulator. A separate 9 V compact battery can thus be used for the electronics. The supplies of the two systems are separated to prevent interference generated by the motors from affecting the electronics. Should you find another motor suitable for the steering circuit but requiring a different supply voltage, a second accumulator will be needed.

The on/off switch can be of the three-pole type, and the two contacts controlled by Re_2 can be supplied separately.

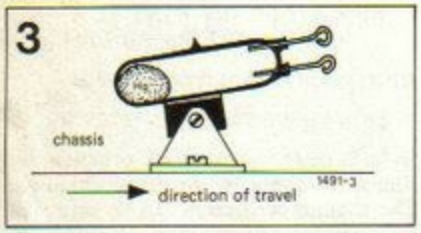
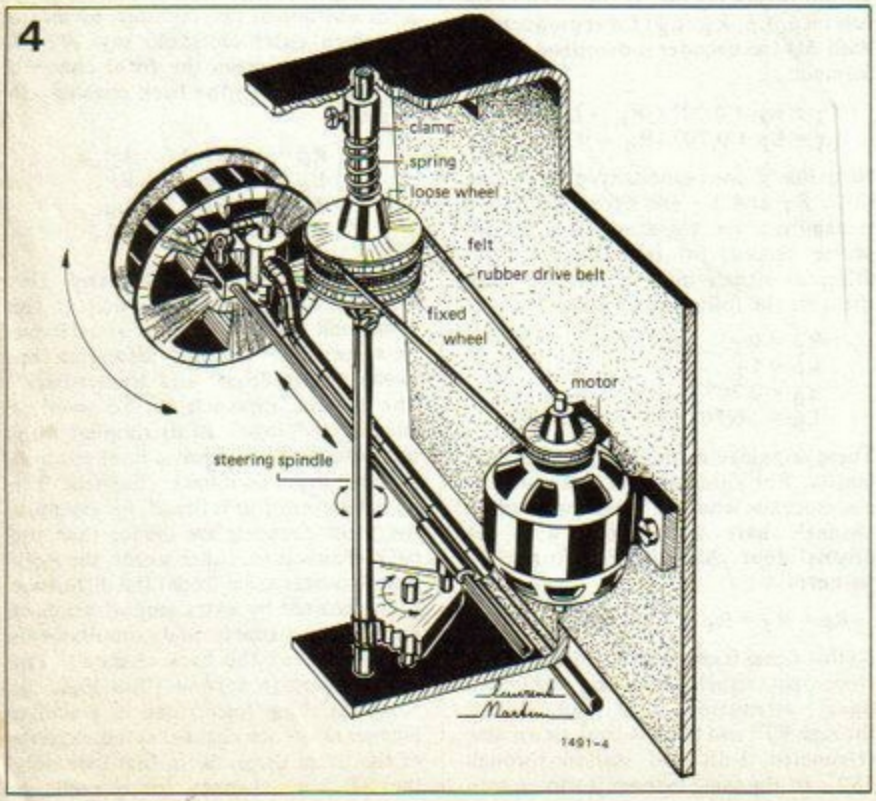


Figure 1. The course the car must follow to arrive at the light source if there are no obstructions.

Figure 2. The complete electronic circuit of the car.

Figure 3. The principle of the mercury switch.

Figure 4. The steering mechanism of the car.



M. Ginolas

micro-squeaker

This circuit is by way of being an electronic joke. The complete circuit comprises only one transistor, one capacitor, a miniature transformer and a headphone. The transistor can be any germanium type; the transformer can be any miniature type with a turns ratio between 3:1 and 10:1. At supply voltages as low as 0.2 V the headphone produces a distinct sound. Current consumption is then of the order of 10μA, power consumption is less than 2μW. The joke of this microsqueaker is that it is not fed from a 'normal' current source, but that the gifts of nature are called upon. The positive connection is a piece of bare copper wire, the negative connection is a bare piece of steel or silver wire. If both ends are stuck into an apple, a lemon or a potato, at some distance from each other, the apparatus produces a tone. A solar cell could also serve as the voltage source. The squeaker may also be used as an indicator for D.C. voltages in the range of 0.2 V ... 10 V.