reading-in-bed limiter

At a certain age, children are often packed off to bed with the final admonition: 'All right, you can read in bed for a quarter of an hour, but then you must turn off the light and go to sleep'. However, as most parents will know, the children tend to suddenly loose all sense of time in this situation . . .
When a member of the Elektor design team was faced with this problem, he started looking for an electronic solution. The final circuit, as published here, has proved extremely effective.

In the situation outlined above, what is really required is a unit that will automatically turn off the bedside reading lamp after the specified time has elapsed. This time switch must have a few special features:
– It should only be possible for the parent(s) to switch on the lamp. This

Figure 1. Complete circuit of the reading-in-bed limiter. S1 must be a key-switch that can only be operated by the parents.

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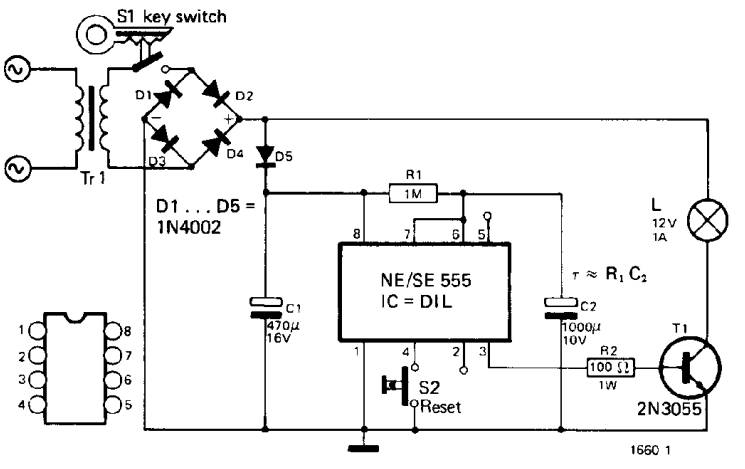

can be achieved by using a key switch.
- It should be possible for the child to turn off the lamp before the alotted time has elapsed, if it finds that it is getting too sleepy to read. Since the child hasn't got the key to the main switch, a further reset button is required.
- For safety reasons, it is essential to use a low-voltage lamp. The whole circuit, including the lamp, should be run off a reliable mains transformer. Since they are easy to obtain, a logical choice is to use a 12 V lamp as used in cars.

The circuit

The obvious choice for the timer itself is the 555 timer IC, since this can be set to give delay times up to several hours with complete reliability. Furthermore, the obvious transistor type to use for switching the lamp is the well-known 'work-horse' the 2N3055. Having chosen these two components, the circuit design is almost finished! The complete circuit is shown in figure 1.

The IC is used as a monostable multivibrator (MMV). The duration of the output pulse is set by a single RC-network, R1 and C2. In this particular application, the pulse duration is practically equal to the RC time. If R1 is 1 M and C2 is 1000 μ, as shown, the RC time is 1000 seconds, or just over a quarter of an hour. Note that any leakage in C2 will extend this time appreciably; for this reason it is advisable to use a tantalum electrolytic, and not to increase the value of R1 any further.

Initially, C2 is discharged. When the circuit is switched on via the key-switch S1, C2 starts to charge through R1. During this time, the output of the IC (pin 3) is at positive supply level. This turns on transistor T1, lighting the lamp. R2 limits the base current to the transistor. With the type of lamp shown (12 V, 10 . . . 15 W), the dissipation in T1 should be so low that a heat sink is not required. The supply to the lamp is the raw, full-wave rectified supply voltage. There is nothing to be gained by smoothing this supply.

An extra diode (D5) and a relatively small smoothing capacitor (C1) are used for the supply to the IC.

When the RC-time has elapsed, the output of the IC switches to 0 V, turning off T1 and the lamp. Pushing the reset button (S2) will switch the lamp off sooner. Since the 'set' input (pin 2) is not used, the only way to switch the lamp on again is to first turn the supply off, wait until C2 has discharged, and then switch on again. Officially, this should be done with the key-switch. It is not advisable to demonstrate even once that the same effect can be produced by pulling out the mains plug for a short time . . .

A printed circuit board layout for the unit is shown in figure 2.

Note that sufficient care should be taken with the mains connection. Use good cable, a rubber grommet where the cable enters the box, and some form of clamp over the cable just inside the box so that there is no 'pull' on the connection to the transformer.

Figure 2. Printed circuit board and component layout for the unit. T1 can be mounted on the board, since a heat-sink should not be necessary (EPS 1660).

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Parts list:

Resistors:
R1 = 1 M
R2 = 100 Ω

Semiconductors:
IC = 555
T1 = 2N3055
D1 . . . D5 = 1N4001, BY126, etc.

Capacitors:
C1 = 470 μ/16 V
C2 = 1000 μ/10 V

Sundries:
S1 = key switch
S2 = reset push button
L = 12 V/1 A lamp
Tr1 = transformer, 12 V/1 A