

# Decade resistance boxes

## Description

A decade resistance box is a passive circuit of which the electrical resistance can be adjusted step-by-step. The resistance box is composed of several adjustable components, which differ because the resistance per component increases by a factor of 10.

Example: A three-decade resistance box consists of three resistance components:

- The first component can be adjusted from 0  $\Omega$  to 1  $\Omega$  in ten steps of 0.1  $\Omega$
- The second component can be set in 10 steps from 1  $\Omega$  from 0  $\Omega$  to 10  $\Omega$
- The third component can be set in 10 steps from 10  $\Omega$  from 0  $\Omega$  to 100  $\Omega$

By connecting the components in series (to be connected one after the other), the total resistance will be the sum of the set resistance of the individual components. In this case, the total resistance can be set in steps of 0.1  $\Omega$  between 0  $\Omega$  and 111  $\Omega$ .



**Fig. 1.** Bleeker decade boxes in the collection.

## Applications

Decade resistance boxes have been used in circuits where a resistance has to be set very accurately. There are many applications for this. Examples:

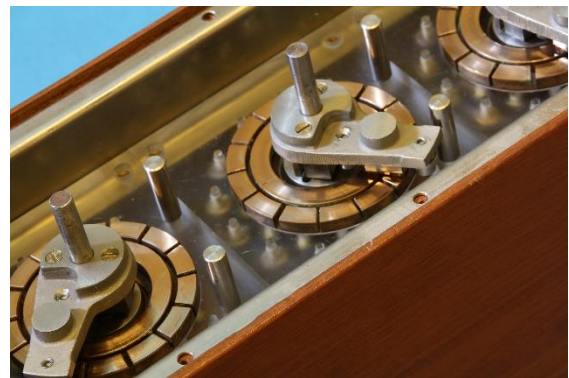
- In combination with a stable voltage source, accurate currents can be set.
- In a bridge, a decade resistance box can be used to determine an unknown resistance. (see also e.g. Wheatstone bridges).
- Voltage dividers, e.g. in compensators.

## Bleeker decade resistance boxes

The Dutch Optics and Instruments Factory Dr. C.E. Bleeker N.V. produced many variants of resistance boxes ranging from 1 to 6 decade units and with a maximum range of 0.01  $\Omega$  to 100 k $\Omega$ . There are variants with two contact points, but also with intermediate contact points, allowing resistance ratios to be set. Specific decade resistance boxes were also produced for high loads of large currents; and boxes for specialised purposes, such as simulators for Platinum thermometers (Pt100 simulator).

## Technic

The resistors in the individual components are wired. The setting takes place via contact brushes. The wire types, the winding methods and the construction are maximally oriented to obtain a very high accuracy, reproducibility and stability. The contact resistance is very low, and thermo-voltages are avoided.



**Fig. 2.** Details of the resistors and the contacts.

## Specifications and prices

Bleeker delivered the decade resistance boxes with an inspection certificate. The specifications of the series 33000 indicate that the tolerance is 0.005% (with a maximum load of 0.1 Watt) and that the stability is 0.003% per year. The zero resistance (resistance when all components are set to 0  $\Omega$ ) is max. 1.5 m $\Omega$  per resistor. In February 1975 the commercial prices of the resistance boxes diverged from fl 480.- for the simplest 2-decade resistance box to fl 2,510.- for a 6-decade resistance box.

Converted to current euros and adjusted for inflation, these resistance boxes would now cost between € 650.- and € 3,400.-.

### Collection

The collection of the Foundation for Historical Microscopy contains dozens of resistance boxes, varying from 1 to 6 decade units.



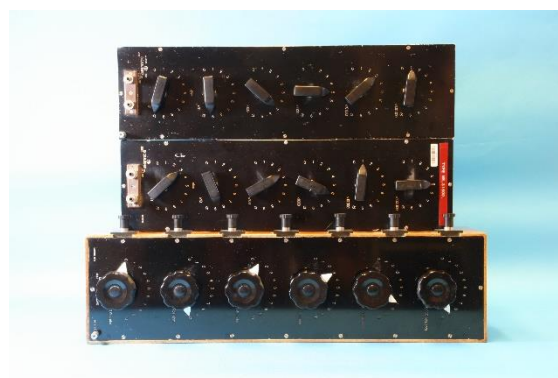
**Fig. 3.** Two-decade resistance boxes.



**Fig. 6.** Five-decade resistance boxes.



**Fig. 4.** Three-decade resistance boxes.



**Fig. 7.** Six-decade resistance boxes.



**Fig. 5.** Four-decade resistance boxes.