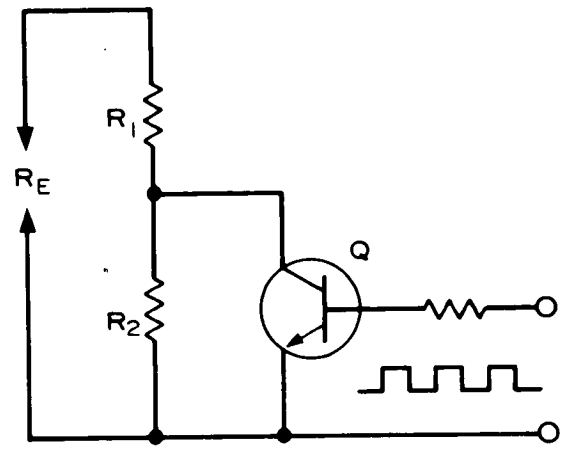
NASA TECH BRIEF

NASA Pasadena Office

Time-Adjusted Variable Resistor

The problem:

To vary the effective value of a fixed resistor and obtain a desired resistance with extreme precision.



The solution:

All or a portion of the fixed resistor is shunted by a switch; the effective resistance of the assembly over an interval of time can be varied by adjusting the rate of closure of the switch.

How it's done:

The elements of the time-adjusted variable resistor are indicated in the diagram where R_1 and R_2 represent two resistors and Q_1 is an electronic switch. In principle, Q_1 could be a mechanical switch operated at low frequencies, but it is more convenient to use a transistor because it can be operated for long periods of time at very high frequencies with no contact noise. If the length of time the switch is open is designated as T_o and the length of time the switch is closed is T_c, then the duty cycle of the switch is $1/(T_o + T_c)$. For the simple case where R_1 is zero, the resistance of the open switch is infinity, and the resistance of the closed switch is zero, the effective resistance, R_E, of the combination obviously is $R_E = R_2 (T_o/(T_o + T_c))$. The effective resistance can be raised essentially from zero to R_2 by varying the duty cycle. When R_1 is not zero, the effective resistance can be varied from R_1 to $(R_1 + R_2)$, and by utilizing other combinations of resistors and switches, a wide variety of effective resistances can be obtained. Of course, the transistor must be driven hard on and then full off, and the "on" resistance should be a very small fraction of R_2 while the "off" resistance should be very large.

At present, extremely precise fixed resistors and timing mechanisms are available at reasonable cost; in contrast, variable resistors capable of being set to a desired value with high precision are relatively expensive. Thus, a time-adjusted variable resistor of the type described above can be used economically in any circuit which is insensitive to the rate of switching; a typical example is a DC Wheatstone bridge which uses a highly damped galvanometer as a detector.

Notes:

1. A practical use of the time-adjusted variable resistor is indicated in Tech Brief B72-10507.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP72-10116

(continued overleaf)

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

NASA Patent Counsel
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