Report
3038

Poor quality original

DEC 5/60 (Engineering/
computing)

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A program to compute series-
parallel resistances

A computer program to compute the effective value of power resistors combined in series-parallel as a battery discharge load

Introduction

Nickel-cadmium batteries require frequent use to maintain their charge mobility and power capacity. Manufacturers recommend that maintenance of standby sources and the reinvigoration of sluggish batteries should be accomplished by taking them through several controlled charge/heavy discharge cycles. This refreshes the charge mobility of the electrolyte and provides an opportunity for an assessment of the ampere-hour capacity.

For this discharging procedure, a resistive load capable of considerable power dissipation is required. As this was a problem arising quite often in the maintenance of Geophysics section equipment, a variable load had to be constructed, in this case using power resistors available from the Laboratory's stores, although a continuously variable rheostat would have been preferable.

The resistors were mounted separately between insulated screw terminals on a base board, giving a flexible choice of interconnection. The purpose of the program was to analyse various combinations under a range of applied voltage, while remaining within the power rating of the individual resistors. In addition, it allowed one of us (G [illegible]) to gain experience with the Honeywell MkIII time-sharing system.

The computer program

Written in Honeywell [illegible] 17, the program computes the total resistance of a series-parallel combination of resistors, as shown in Fig [illegible]. The number and values of the components and the applied dc voltage are entered from the terminal keyboard by the user and it then calculates the values of current and power dissipation in each resistor in turn, and in their effective total resistance. The standard, basic equations employed are listed in Table 1; a sample output and program listing follow in Tables 2 and 3.

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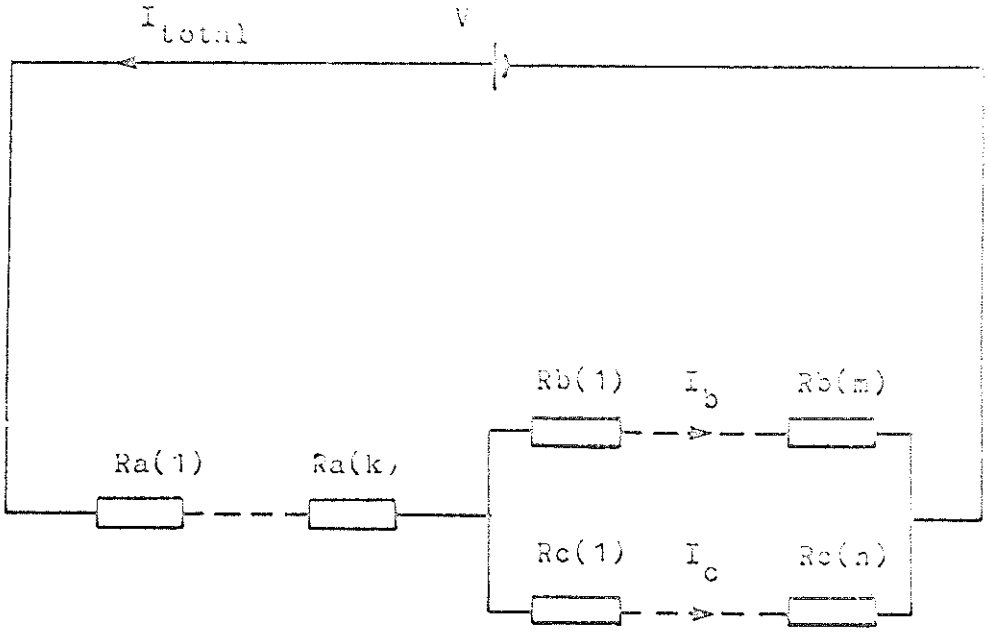

Fig. 1 Circuit layout

$$R_{total} = Ra_{total} + \frac{Rb_{total} \times Rc_{total}}{Rb_{total} + Rc_{total}} \quad (1)$$

$$I_{total} = \frac{V}{R_{total}} \quad (2)$$

$$I_b = I_{total} \times \frac{Rc_{total}}{Rc_{total} + Rb_{total}} \quad (3)$$

$$I_c = I_{total} - I_b \quad (4)$$

$$\text{Power in } R(x) = I_x^2 \times R(x) \quad (5)$$

Table 1 Equations used in program

```
*********************************************************************
* This program calculates the effective total resistance of a
* parallel series combination of power resistors used as load
* for battery testing. The numbers and values of resistors in
* each series, and the source voltage, are optional. It also
* computes the current and power in each component.
* Written by R Haddon Reece, Ancient Monuments Lab, Dec, 1980
* expanding and revising a previous version by G D McDonnell.
*
*                    +----B----+
*   o----A----|              |------o
*                    +----C----+
*
*********************************************************************
      OPTION NOWARN
      REAL A(6,10),RTOT(3),AMP(3); INTEGER NUM(3)
      STRING TAG(4)/'1','2','3',' '/
*
* INPUT SECTION
*
  250 PRINT,"ENTER NUMBERS OF RESISTORS: A- B- C-SERIES"
      INPUT,(NUM(L),L=1,3)
      PRINT,"ENTER SERIES IN TURN"
      DO 300 I=1,3
      N=NUM(I)
      INPUT,(A(I,J),J=1,N)
  300 RTOT(I)=0
      PRINT,"ENTER SOURCE VOLTAGE"
      INPUT, VOLT
*
* CALCULATE VALUES
*
      DO 380 K=1,3
      N=NUM(K)
      DO 380 L=1,N
  380 RTOT(K)=RTOT(K)+A(K,L)
      RTOTAL=RTOT(1)+RTOT(2)*RTOT(3)/(RTOT(2)+RTOT(3))
      ATOT=VOLT/RTOTAL
      AMP(1)=ATOT
      AMP(2)=ATOT*RTOT(3)/(RTOT(2)+RTOT(3))
      AMP(3)=ATOT-AMP(2)
      DO 460 M=1,3
      N=NUM(M)
      DO 460 MM=1,N
  460 A(M+3,MM)=(AMP(M)**2)*A(M,MM)
*
* OUTPUT SECTION
*
      DO 560 I=1,3
      N=NUM(I)
      PRINT610,"OHMS ",TAG(I),(A(I,J),J=1,N)
      PRINT610,"WATTS",TAG(4),(A((I+3),J),J=1,N)
  560 PRINT," "
      PRINT620,"VOLTS=",VOLT,"AMPS=",ATOT,"TOT.RES=",RTOTAL
      PRINT,"ANOTHER COMBINATION: 1=YES, 0=NO"
      INPUT,REPLAY
      IF(REPLAY.EQ.1)GOTO 250
  610 FORMAT(1H ,A5,A1,2X,10(F6.2))
  620 FORMAT(1H ,A6,1X,F5.1,2X,A5,1X,F6.2,2X,A8,1X,F5.1//)
      CALL EXIT
      STOP; END
```

```
READY

RUN 26


POWER        18:12        02-14-80


ENTER NUMBERS OF RESISTORS: A  B  C SERIES?2,3,4

ENTER SERIES IN TURN?1,1
?2,2,1,1
?2.2,2.2,2.2,2.2
?2.2

ENTER SOURCE VOLTAGE?10

OHMS-1      1.00  1.00
WATTS       3.71  3.71

OHMS-2      2.00  2.00  1.00
WATTS       3.02  3.02  1.51

OHMS-3      2.20  2.20  2.20  2.20
WATTS       1.07  1.07  1.07  1.07

VOLTS=  10.0  AMPS=   1.93  TOT.RES=   5.2

ANOTHER COMBINATION: 1=YES, 0=NO?1

ENTER NUMBERS OF RESISTORS: A  B  C SERIES?1,3,3

ENTER SERIES IN TURN?2.2
?1,1,1
?2.2,15,1

ENTER SOURCE VOLTAGE?6

OHMS-1      2.20
WATTS       3.47

OHMS-2      1.00  1.00  1.00
WATTS       1.16  1.16  1.16

OHMS-3      2.20 15.00  1.00
WATTS       0.07  0.47  0.03

VOLTS=   6.0  AMPS=   1.26  TOT.RES=   4.8

ANOTHER COMBINATION: 1=YES, 0=NO?0


USED     4.09 UNITS
```

```
RUN

POWER        10:14        02 14 80

ENTER NUMBERS OF RESISTORS: A  B  C SERIES?1,2,4

ENTER SERIES IN TURN?2.2
?2.2,2.2
?15,15,2.2,1

ENTER SOURCE VOLTAGE?6.3

OHMS-1       2.20
WATTS        2.36

OHMS 2       2.20  2.20
WATTS        1.84  1.84

OHMS 3      15.00 15.00  2.20  1.00
WATTS        0.22  0.22  0.03  0.01

VOLTS     6.3  AMPS=    1.04  TOT.RES=    6.1

ANOTHER COMBINATION: 1=YES, 0=NO?1

ENTER NUMBERS OF RESISTORS: A  B  C SERIES?2,4,4

ENTER SERIES IN TURN?2.2,1
?2.2,2.2,2.2,2.2
?15,15,15,15

ENTER SOURCE VOLTAGE?6.3

OHMS 1       2.20  1.00
WATTS        0.74  0.34

OHMS 2       2.20  2.20  2.20  2.20
WATTS        0.56  0.56  0.56  0.56

OHMS 3      15.00 15.00 15.00 15.00
WATTS        0.08  0.08  0.08  0.08

VOLTS=    6.3  AMPS=    0.58  TOT.RES=   10.9

ANOTHER COMBINATION: 1=YES, 0=NO?0


USED      4.11 UNITS
```