VOLTAGE DISTRIBUTION ACROSS A STRING OF INSULATORS

OBJECT: To determine the voltage distribution across a D.C. model insulator string with and without a guard ring and to determine the string efficiency for each case

APPARATUS

Model insulator string

One 270 ohm 1.3 A rheostat
One 0-100 V D.C. voltmeter
One 0-100 mA D.C. ammeter

Procedure

The apparatus is first connected as shown in Fig.1. The D.C. supply is switched on and the rheostat adjusted until the D.C. voltage across the string is 100V as indicated on the voltmeter. The voltmeter is then connected in turn across each unit and the voltage measured. These results are then tabulated. The current in each branch is also measured by removing each link in turn and inserting the ammeter; the main supply being switched off before making any circuit alteration.

The apparatus is reconnected as shown in Fig.2. The D.C. supply is switched on and again the rheostat adjusted until the D.C. voltage across the string is 100 V. The voltmeter is then connected in turn across each unit and the voltage measured as in the previous test. The readings are tabulated.

TABULATED RESULTS

TEST 1 NO GRADING RING		TEST 2 GRADING RING		
VOLTAGE,V	CURRENT, mA	VOLTAGE,V	CURRENT, mA	
V1 =	I1 =	V1 =	I1 =	I5=
V2 =	I2 =	V2 =	I2 =	I6=
V3 =	I3 =	V3 =	I3 =	I7 =
V4=	I4 =	V4 =	I4 =	I8 =
	I5=			
	I6=			

CALCULATIONS

$$\text{String Efficiency} = \frac{100}{4 * \text{Highest unit voltage}} * 100 \%$$

Determine the string efficiency for the two cases.

Check also the current distribution using Kirchhof's laws

CONCLUSIONS

1. Explain why the voltage across each unit varies and why this is a disadvantage
2. Explain the effect of fitting a grading ring, and comment upon the relative string

Read Chapter 4, Section 4.1 (Guile & Patterson, Vol.1) and answer the following questions:
- Why are insulators required?
- What two materials are used for insulators? Compare their characteristics.
- What kind of protection do insulators afford to the overhead line?
- Name three types of insulators & describe them.
- What are the causes for insulator failure?
- Define the term -creepage distance
- Solve the following problem:

A suspension insulator string comprises 4 similar units, the self-capacitance of, each of which is 4 times that between each link-pin and earth. If the conductor is energised at 76 kV, measured with respect to earth, find the voltage across each unit and the string efficiency.

Reference: Chapter 10: Transmission & Distribution of Electrical Energy by H. Cotton

FIG.1

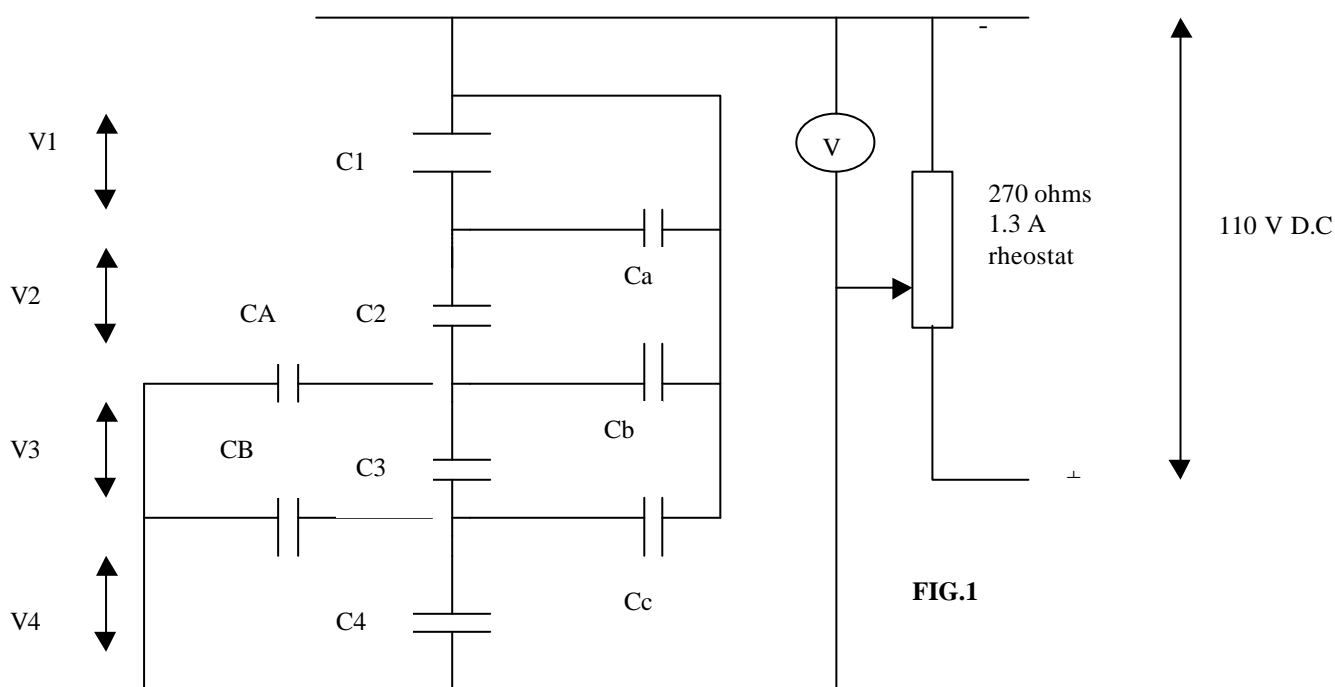FIG.**2**   Same as FIG.1, but the left-hand capacitors are connected to the C1C2C3C4 string

In the Laboratory , the capacitors may be replaced by radio resistors of appropriate values for use on a 100 V D.C supply. The following values are suggested.
R1=R2=R3=R4 = 1K
Ra=Rb=Rc=5.6 K, RA=RB=1.8 K
RA=RB=1.8 K