TECHNICAL NOTE NO. ML 10201

FOR

"SELECTION OF LONGROD INSULATORS FOR POLLUTED ZONE"

C.M. JAIN

H.V.V. MURTHY

SELECTION OF LONGROD INSULATORS FOR POLLUTED ZONE

INTRODUCTION :

Pollution behaviour is part of Electrical characterstics of an insulator, it nevertheless plays a special role due to its importance for the insulation. Pollution flashover is the process of partial arc which short circuits between two ends of insulator. Based on many years of experience longrod insulators gives 20% better performance than cap and disc insulator. This advantage is gained by the design of longrod insulators.

During the service life of overhead line, insulators are subjected to following stresses :

1. Electrical Stress
2. Mechanical Stress
3. Environmental Stress

Usually electrical stress and mechanical stress will be taken care during design but environmental stress can be taken care after knowing certain information from the user.

GENERAL INFORMATION REQUIRED

Nominal voltage of the system and highest voltage of equipment.

Information about overhead line :

1. Type of tower
2. No. of circuits
3. Ground clearance
4. Insulator protective fittings

Information on site

- Map of area crossed and routing of the line.
- The different climatic zones crossed by the line.
- Place and orientation and altitude.

Information on weather conditions

- Type of climate
  a) Temperature
  b) Relative humidity
- Annual rain fall

- Dominant wind
- Fog and dew

Information on pollution

1. Saline pollution
2. Industrial pollution (cement)
3. Chemical industrial pollution (Gas or smoke)
4. Mixed pollution

Position of string

Vertical, Horizontal, Angle, No. of units of strings, creepage distance, spacing, type of insulator.

Additional information

1. Maximum leakage current monitoring
2. Vibration parameters on line

Knowing the above information longrod insulators are designed to suit different polluted area. Pollution level and creepage distance requirement as defined in IEC-815/1986 are as below :

Pollution Level		Area	Nominal creepage Distance required
1.	Light	Without industries agricultural land	16mm/kV
2.	Medium	Industries not providing smoke	20mm/kV
3.	Heavy	High tensity of house area closed to sea	25mm/kV
4.	Very Heavy	Very closed to sea coast desert area where there is no rain	21mm/kV

Design Parameters

Pollution performance of insulator in service is governed by the leakage distance when other design parameters like clearance between shed, shed overhang and shed inclination are optimized.

- The clearance between shed should not be below a minimum value so that the risk of discharges between sheds short circuiting a part of the leakage distance is avoided.

- Shed profile facilitates the self cleaning process. Plain shed profiles are highly successful because of excellent cleaning properties. Similarly plain sheds with steeper inclination are advantagious in liquid contaminated area. Alternate shed profile gives better performance then normal shed design. (pl refer fig.1 with different types of profiles).

- To obtain certain leakage distance more shed with smaller diameter is preferred than few shed with larger diameter.

It is feasible to provide grading rings in case of longrod insulator. It improves RIV performance and voltage distribution. It is possible to use grading ring in centre in case of 220 kV and 420 kV strings to avoid thermal stress due to power arc on the transmission line.

The fig.2 shows the results of power arc test of suspension and long rod Insulator. This test was conducted on disc suspension insulator string and longrod Insulator without arcing device under a load of 500 - 2000kg. The longrod Insulator has much greater arc resistability then the disc type.

Longrod insulator exhibits higher withstand level at higher salinity of pollution compared to disc and cap insulator. Report received from CPRI indicates that longrod insulator is superior to string of standard and antifog disc insulator. For example 132 kV class withstand voltage of longrod insulator was found 2 to 3 steps higher than disc insulator. 220 kV class withstand voltage is 15% higher than disc. 400 kV class also gives better performance than disc insulator. Fig.3 shows withstand salinity V/s specific creepage distance.

If few sheds of longrod insulator breaks, no obstruction to the power transmission line will occur because, there is no decrease in flashover voltage as shown in fig.4. Because of this, immediate replacement upon discovery of damaged insulator is not necessary and it can be left as it is and replaced when convenient.

Generally corrugated structure of shed result in unfavourable design regarding performance under highly contaminated layers. The main events leading to flashover of polluted insulator under service voltage condition is due to the formation of conducting layers. Leakage current surging associated with dry band formation and partial arc development and arc propogation along the insulator surface.

The phase of flashover development (Fig.5)

1. Heating of surface layer cause increase in conductivity and current.

2. Continued heating leads to local drying of surface layer.

3. Further heating cause dry zone formation by natural drying.

4. Partial arc across the dry zones is a distinct behaviour feature of contaminated insulator.

5. Intensive radio noise emitted from insulator.

6. Many arc merge to form single arc bridging large portion of insulator.

The figure 6 shows the salinity V/s leakage current characteristic.

The study of insulator under natural pollution condition is most important for assessing their actual performance. No single test method can simulate all the effects prevailing under natural condition of pollution nor actual flashover value be assessed completely by only one method.

MODERN's insulator were tested at CPRI Bangalore with different salinity level and insulators have withstood upto 56Kg/m^3 salinity level at its operating voltages. Testing procedure is given below.

Before starting the test the metal part and cement was painted with salt water resistant paint. Then the insulator was cleaned. Before starting the test the insulator is rinsed with tap water then the insulator was subjected to 56Kg/m^3 salinity rate at 85kV test voltage for 20 minutes. The voltage was raised in steps of 20% of specified voltage every 5 minutes until flashover. It has withstood upto 117 kV for five minutes without any flashover. With the above results, longrod insulator gives better performance then disc & cap insulators.

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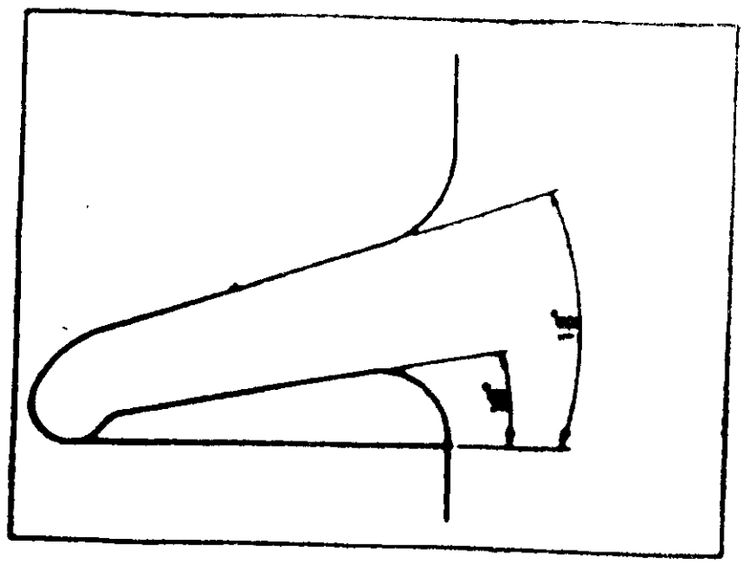


Fig.-A

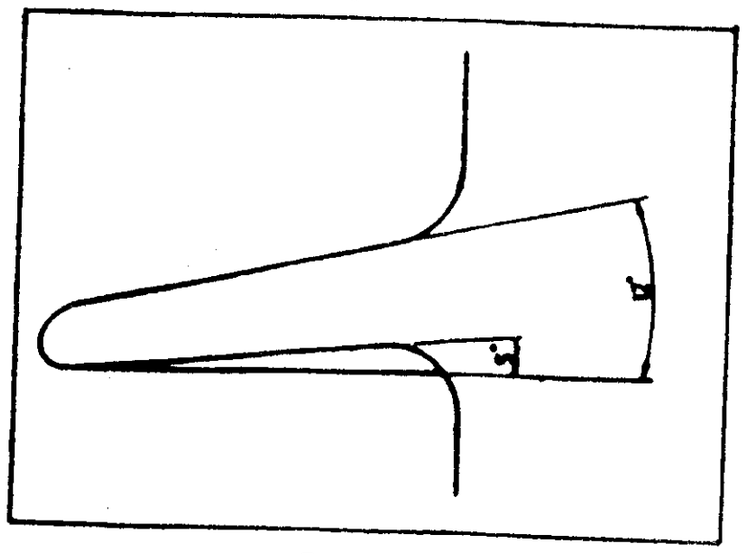


Fig.-B

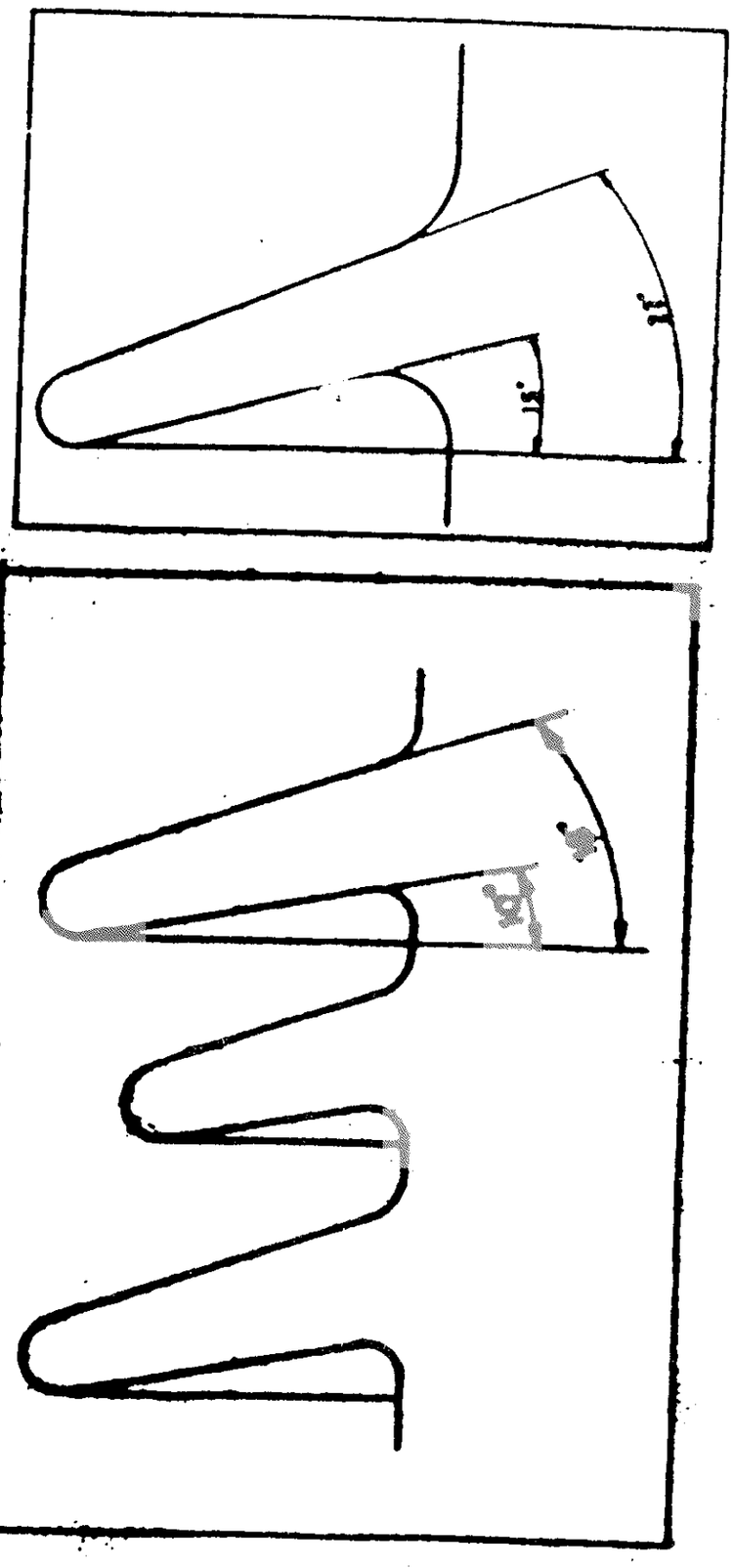


Fig.1 - Shed Profiles

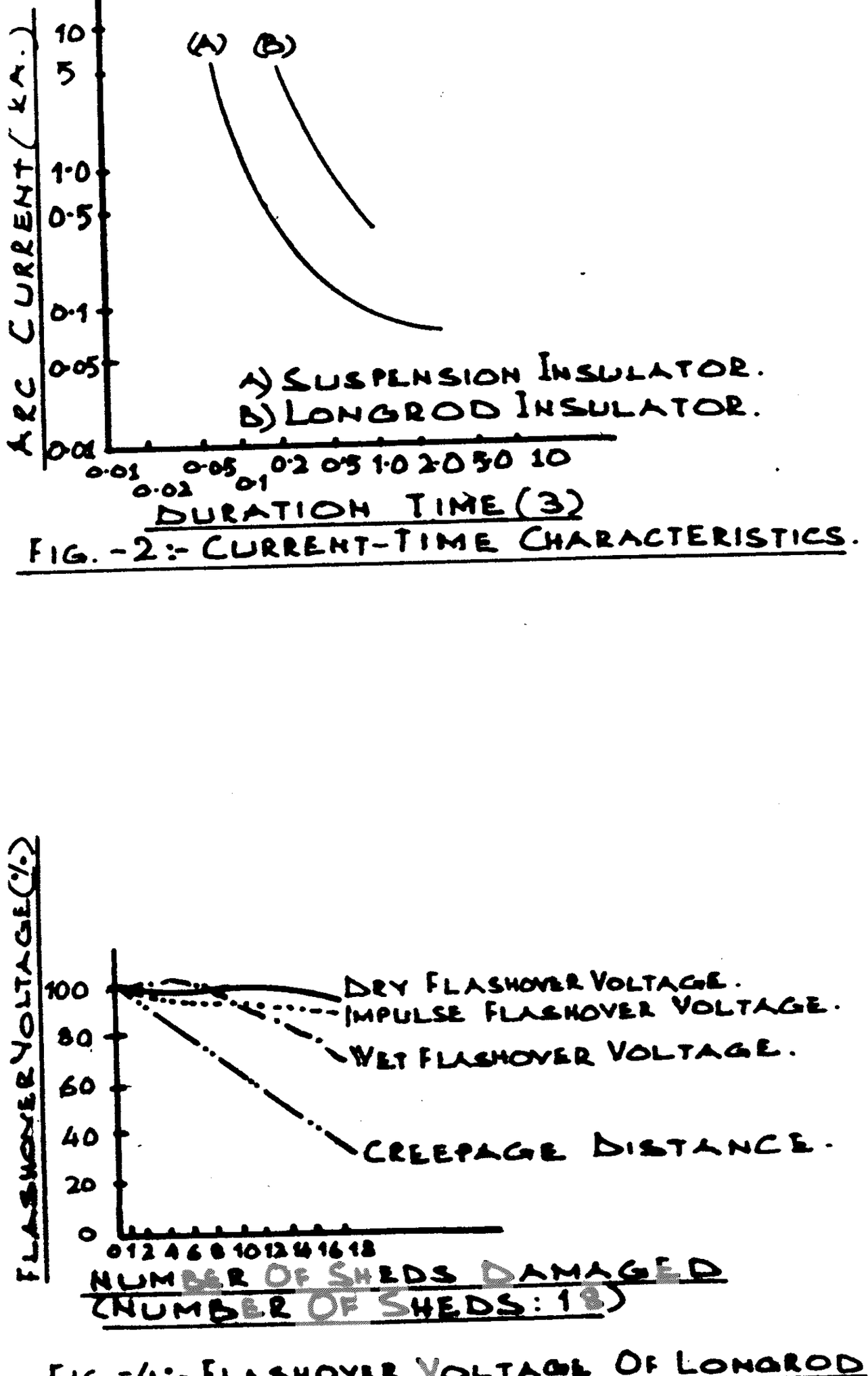


FIG.-2:- CURRENT-TIME CHARACTERISTICS.

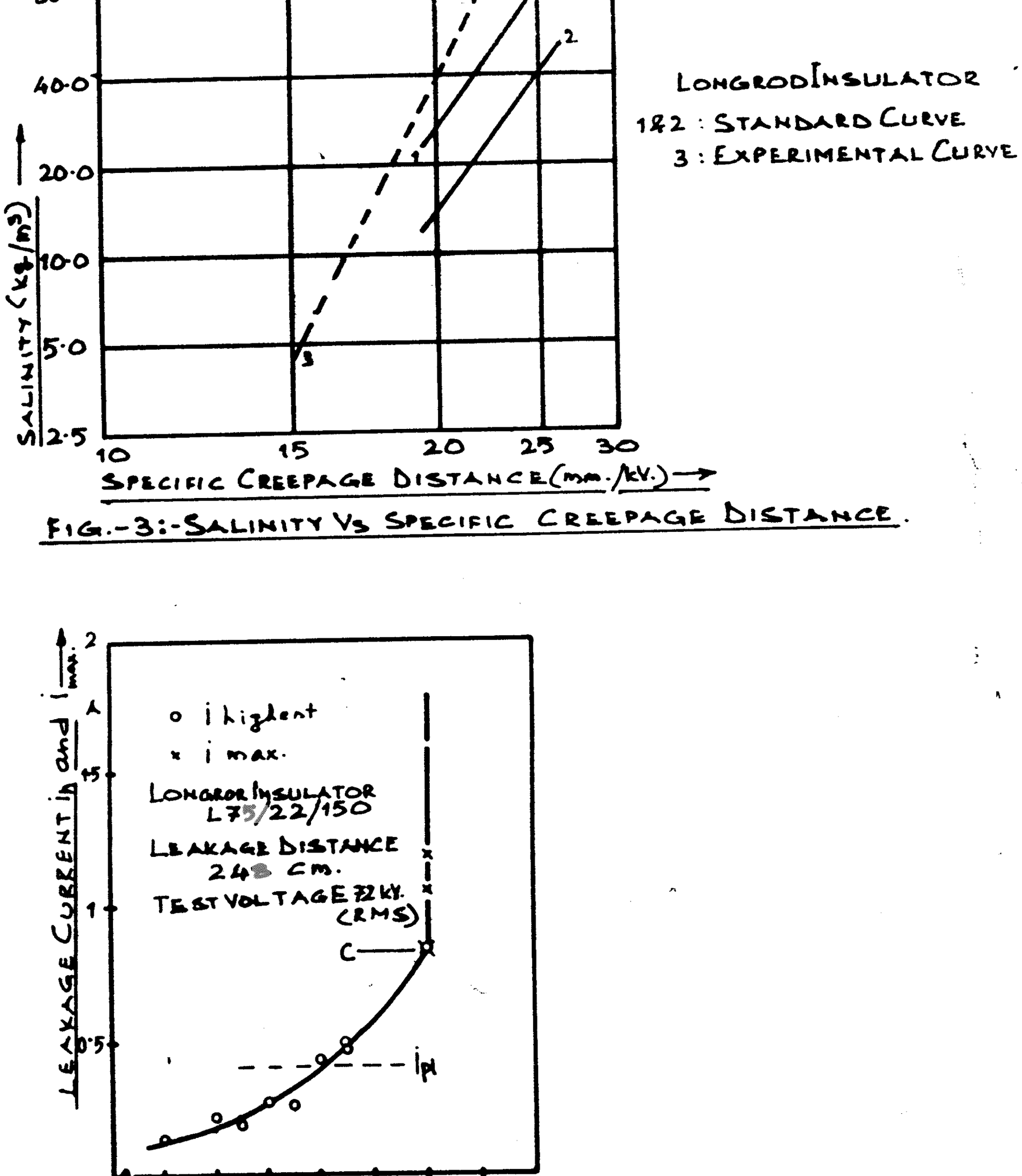
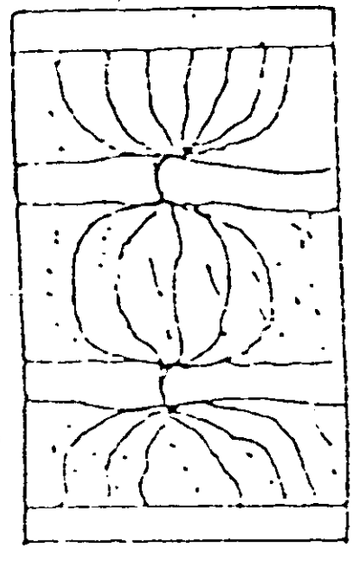


FIG.-3:- SALINITY Vs SPECIFIC CREEPAGE DISTANCE.

FIG.-4:- FLASHOVER VOLTAGE OF LONGROD WITH BROKEN-SHED.

FIG.-6:- LEAKAGE CURRENT CHARACTERISTICS.



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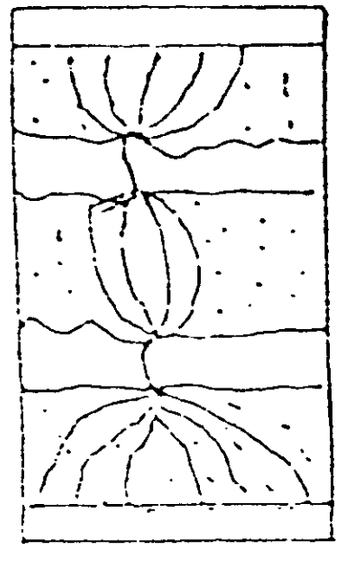

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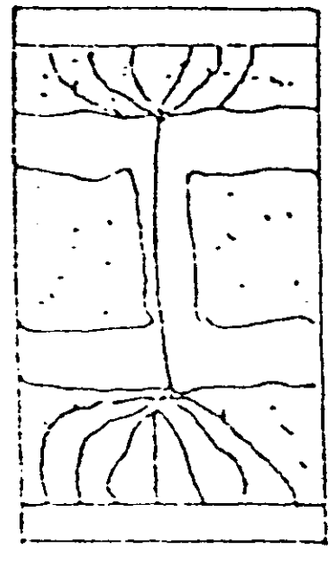

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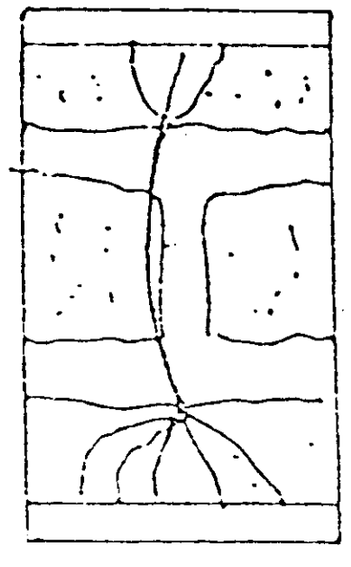

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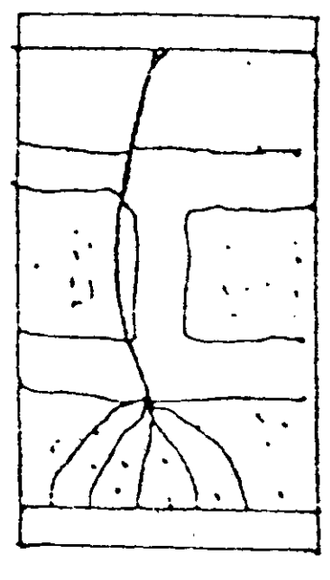

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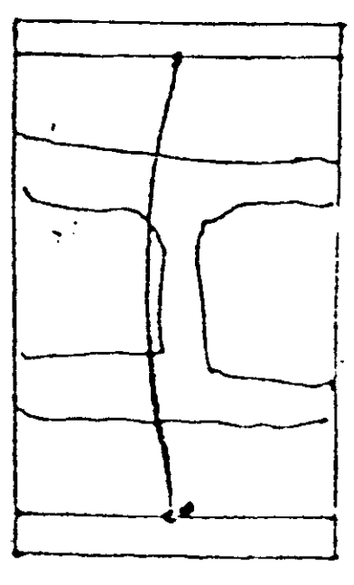
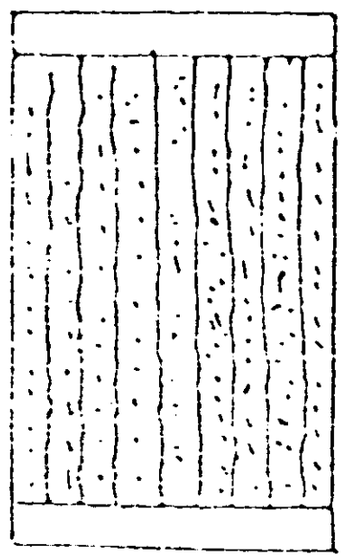


l)

wet contaminant

dry contaminant



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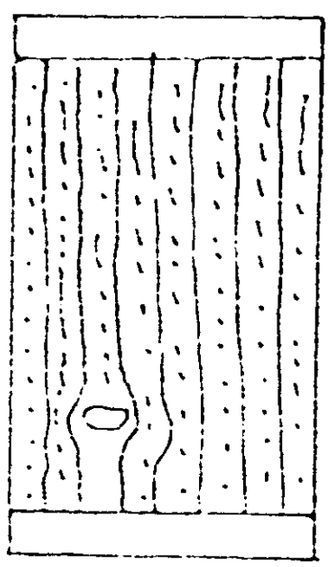

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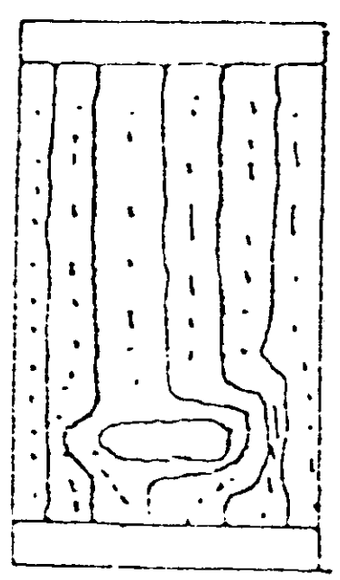

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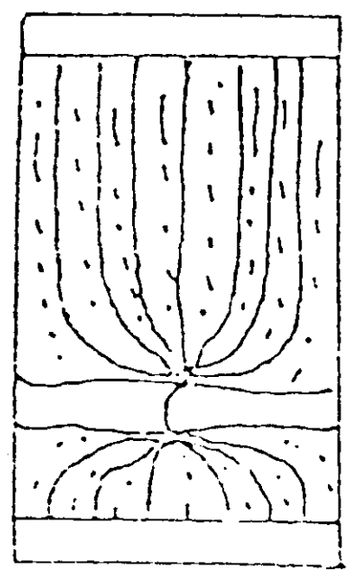

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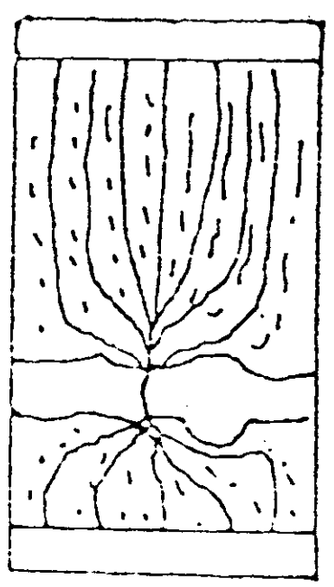

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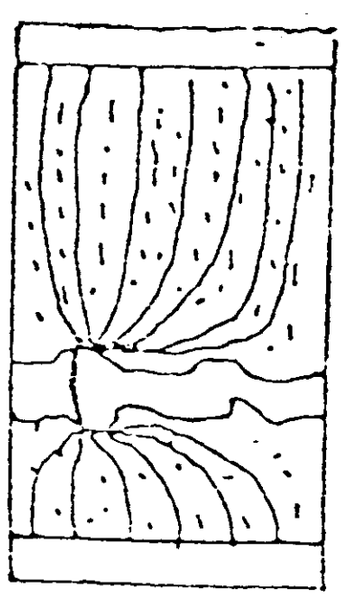

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