ENGINEERING NOTES NO. E-29

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FROM: J. W. Forrester

SUBJECT: Storage Tubes, Phone Discussion with Dr. Rajchman, R.C.A.

DATE: November 6, 1946

The following information was received in a discussion with Dr. Rajchman at the R.C.A. Laboratories in Princeton, New Jersey.

1. Mica, Secondary Emission.

Dr. Rajchman concludes from indirect evidence that mica has a secondary emission ratio of 2.5 at the primary electron beam voltage of 700. They are fairly sure of the upper unity cross over point at between 7000 and 8000 volts. The lower cross over point is in some doubt but probably between 30 and 70 volts. This information has been obtained from interpretations of storage tube operating characteristics.

2. Selectron Tube.

Some progress has been made in the selectron tube but difficulty is being experienced in reading out signals. They are attempting to use electrical output indications in place of the photo cell output. Results have not yet been obtained. No high speed tests have been made but only static characteristics.

3. Dielectric Storage Surfaces.

Rajchman suggested the use of an anodized surface on aluminum as a dielectric. They have made tests on approximately 1 mil thickness which would withstand 60 volts and have a storage time constant of several minutes. They have had little chance to develop a proper technique for applying the oxide layer. A method suggested to them by the Philadelphia Rust Proofing Company is as follows:

Use a 15% H_2SO_4 bath by weight operating at 70°F with air agitation. The agitating should be by generous bubbling of air through the bath to obtain mixing and perhaps also to supply oxygen. A current of 18 amperes per square foot should flow to the metal plate. Approximately a twelve-volt drop across the bath is to be expected. Rajchman has the information that film forms at 0.007" in thirty minutes but he expects this figure may be high by a factor of ten.

If the above bath is not found satisfactory, it is suggested that the concentration of sulphuric acid be reduced to 10% and the temperature to 65°F.

After the acid bath treatment, the metal plate should be boiled in water some two hours. This process it to make the insulation film continuous and to eliminate pin holes. Continuity of the insulation can be checked by immersing the plate in mercury with 50 volts between the mercury and the base metal.

4. Thickness may be measured by dissolving away the oxide coating. For this is suggested the following solution:

35 cc of 85% phosphoric acid
20 grams of chromic acid
water to make 1,000 cc.

5. R.C.A. are planning to obtain oxide coatings using the same material that is applied to heater type vacuum tube filaments. The insulation used on filaments is aluminum oxide in a binder. This has good adhering properties and has a high resistance even at elevated temperatures. The oxide coating on aluminun has obvious mechanical advantages over mica. In addition, the dielectric constant is perhaps higher and the surface leakage may be reduced because of the granular characteristics of the oxide surface as compared to the smooth mica. The length of the surface leakage path is therefore, increased. Rajchman expects surface leakage will be more troublesome than volume leakage in the dielectric film.

6. R.C.A. has had some trouble with ion contamination of the dielectric surface from the cathode in the selectron tubes. They doubt, however, that this trouble would exist in beam deflection tubes where the gun is more than 6" from the dielectric surface.

7. In response to the question about desirability of beryllium deposited in spots on the top surface of the dielectric, Rajchman said that they had tried this idea with chromium. Considerable trouble was experienced with the chromium migrating along the dielectric surface even with the best shielding they were able to provide. This process was carried out with a masked area under the electron microscope and the arrival of the chromium was observed visually. If we try beryllium, Rajchman would be interested to have the results. He expects the same trouble due to migration along the dielectric surface may be experienced.