

Project Whirlwind
Servomechanisms Laboratory
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SUBJECT: GAS-DISCHARGE DATA STORAGE IN HIGH-VOLTAGE DEVICES
(Abstract of Report E-140, Servomechanisms Laboratory)

To: 6345 Engineers

From: R. F. Markel

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The development of large-scale computers is seriously limited by the space required by the data-storage function. Circuit and area storage methods have been used but the desiderata is represented by volume data storage, in which a large number of storage cells may be placed in a three-dimensional array. Such an array employing gas-discharge gaps is described. Storage and selection of data is accomplished by voltage pulses which produce transitions between the dark and abnormal-glow discharge regions. The gap electrode configuration consists of a cathode wire placed concentrically with a hole in a plate anode, insulating walls being used to confine the discharge. The static characteristics of gaps of this type are investigated to determine if the data-storage requirements of stability, accuracy, uniformity, long life and small size can be fulfilled.

Ionizing and deionizing processes active in discharge gaps are first discussed and pertinent published data are assembled as a preliminary step in the investigation.

A theoretical analysis is carried out in which breakdown and extinction voltages are determined as functions of the design variables: type of gas, pressure, type of cathode material, and the electrode dimensions. In this analysis a breakdown threshold criterion is derived and applied, using the electrostatic potential distribution determined approximately by the use of spheroidal coordinates. The glow discharge problem is stated but not solved. The results of this analysis enable an approximate design method to be set up.

Experimental evidence of the effect of certain of the design variables on static performance is obtained by tests on a number of experimental gaps. A vacuum system is used to facilitate the changing of gases and varying the gas pressure. Considerable diffi-

culty was encountered due to random sparking, changes in cathode surface characteristics, and breakdown between leads inside the tubes.

Results indicate that it will be possible to design a gap having satisfactory average performance characteristics. The chief obstacle to success appears to be the problem of insuring stability, both in cathode surface characteristics, and in the glow-discharge itself to a sufficiently high voltage.

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Signed R. F. Markel

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