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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: CONFERENCE ON VACUUM-TUBE PROBLEMS AT SYLVANIA - EMPORIUM

To: J. W. Forrester, H. Fahnestock, H.R. Boyd, N.H. Taylor, P. Youtz
B. Frost, S. Dodd, T. Clough, C. Watt

From: E. S. Rich

Date: October 20, 1949

A conference was held at the Sylvania plant in Emporium, Pa., on October 6, 1949, to discuss problems relating to the design and manufacture of vacuum tubes for use in electronic computers. The following people were present.

Acheson, Chief Engineer
McClintock
Campbell
Slinkman

Sylvania
Emporium, Pa.

Buck
Palmer
G. C. Rich
Dolnick

Sylvania, Research Lab
Kew Gardens, L.I., N.Y.

Fallows

Sylvania - Boston

Youtz
E. S. Rich
Frost

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The principle subjects under discussion were the long range problem of obtaining tubes having satisfactory performance and reliability for computer applications and the immediate problem of improving the 7AD7 for use in WWI in the near future.

Acheson stated that Sylvania is considering plans for an extensive study of vacuum-tube life and reliability aimed at the development of tubes which would be particularly suitable for use in electronic

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computers. A major difficulty in formulating these plans is determining what factors affect life and reliability. Since many of the processes involved in tube production seem to be classed as an art rather than a science, experience gained from construction of one tube does not necessarily apply to the design of another. For this reason the representatives from Sylvania felt that any research attempted should be done on a tube type which would have the most general use in the computer field. They pointed out that about 40 tube types are being used in the various computers at the present time so the selection of a "most desirable type" is a problem in itself.

Prior to our meeting, Sylvania felt there had been conflicting reports from various groups on the kinds of deterioration observed in receiving tubes which are operated for extended periods with heater voltage applied but no cathode current being drawn. After review of our data on apparent-interface formation, it became evident that there are two distinct decay effects which may occur in tubes which are cut-off for long periods. In addition to the interface type of deterioration, in some tubes a "black-out" effect has been observed. Such tubes show an apparent loss of emission after being operated cut-off for a time variously reported to be from a few hours to a few hundred hours. Applying a chain of pulses or drawing a steady current, however, restores the emission to its normal value. Accurate data on the recovery time was not available but its time constant was thought to be of the order of a few milliseconds. Two significant differences were brought out to distinguish this black-out effect from the interface effect. First, a tube with an apparent interface shows no loss of emission at the incidence of a pulse, second an apparent interface may develop in a tube that is continuously conducting during life although low-duty-cycle operation accelerates its formation. (Black-out shows up only if the tube has been completely cut-off.)

It was stated that black-out such as described above occurs in many different types of receiving tubes. To my knowledge it has not been observed in tubes used on this project, except perhaps in the cathode-ray-tube guns used by the storage-tube group. However, our circuit conditions may be such that it does not occur or the effect may have been obscured by the static tests that are applied to the tubes.

Since the discussion on the subject of tube life and reliability seemed only to emphasize the magnitude of the problem rather than point to a method of solution, Acheson felt that no specific long-range tube development program could be started at the present time.

The afternoon was devoted to a discussion of the proposed specifications for an improved 7AD7. These were made up on this project and submitted to Emporium for informal comment in a letter from Fallows

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to Slinkman dated August 22, 1949. The principal changes from the present 7AD7 production that were called for in the proposed specifications were an increase in plate current and elimination of any tendency toward formation of an interface. Slinkman was of the opinion that the plate current increase could be obtained without difficulty. However, they were not confident of being able to build tubes which would not develop interfaces since they are not sure what factors need to be controlled in this respect. From a production standpoint, they stated that our proposal of a 2000 hour accelerated life test to check for interface formation was out of the question. In fact, any life test longer than 500 hours was considered impracticable. It appeared that some more experimental evidence was needed before a decision could be reached, so it was agreed to postpone settlement on the specifications for about a month. In the interim, we will attempt to determine the usefulness of a 500-hour accelerated life test as a means of predicting whether interfaces can be expected to form during a few thousand hours of normal life. At the same time Slinkman will investigate what design changes are necessary to increase plate current and to meet the other specifications on tube characteristics.

Signed:


E. S. Rich

ESR: sst